EUROPEAN EDITION

# EDN®

THE DESIGN MAGAZINE OF THE ELECTRONICS INDUSTRY

DECEMBER 8, 1994



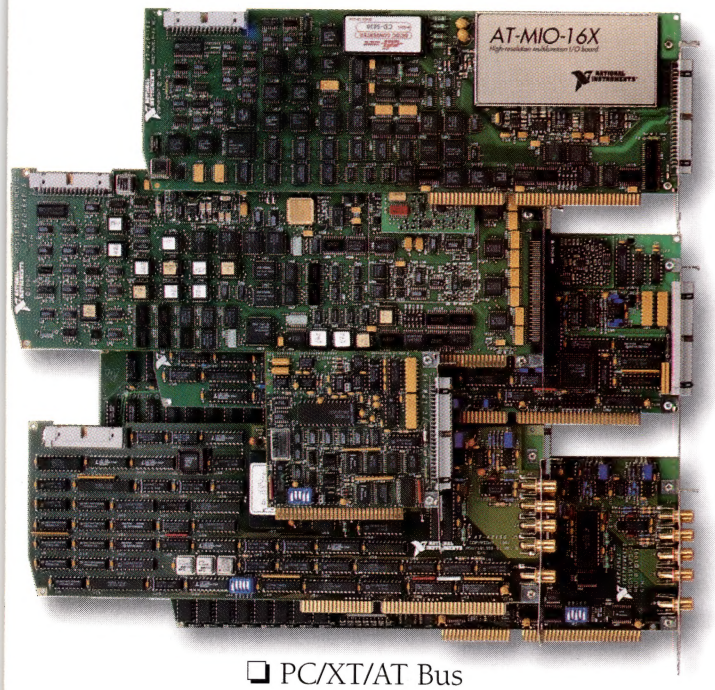


# 100 HOT PRODUCTS 1994

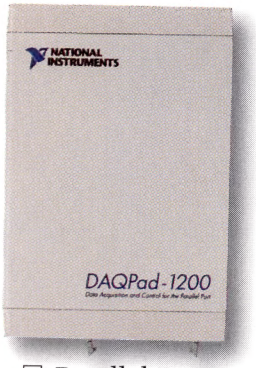


A CAHNERS PUBLICATION

# Multiple Choice.

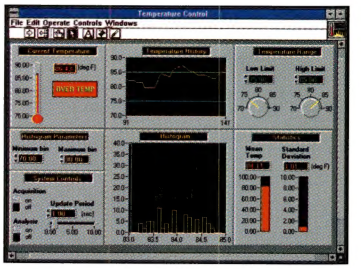



❑ PC/XT/AT Bus

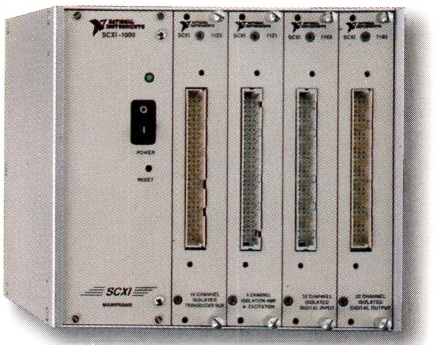



❑ Parallel Port


❑ PCMCIA



❑ Software




❑ Signal Conditioning

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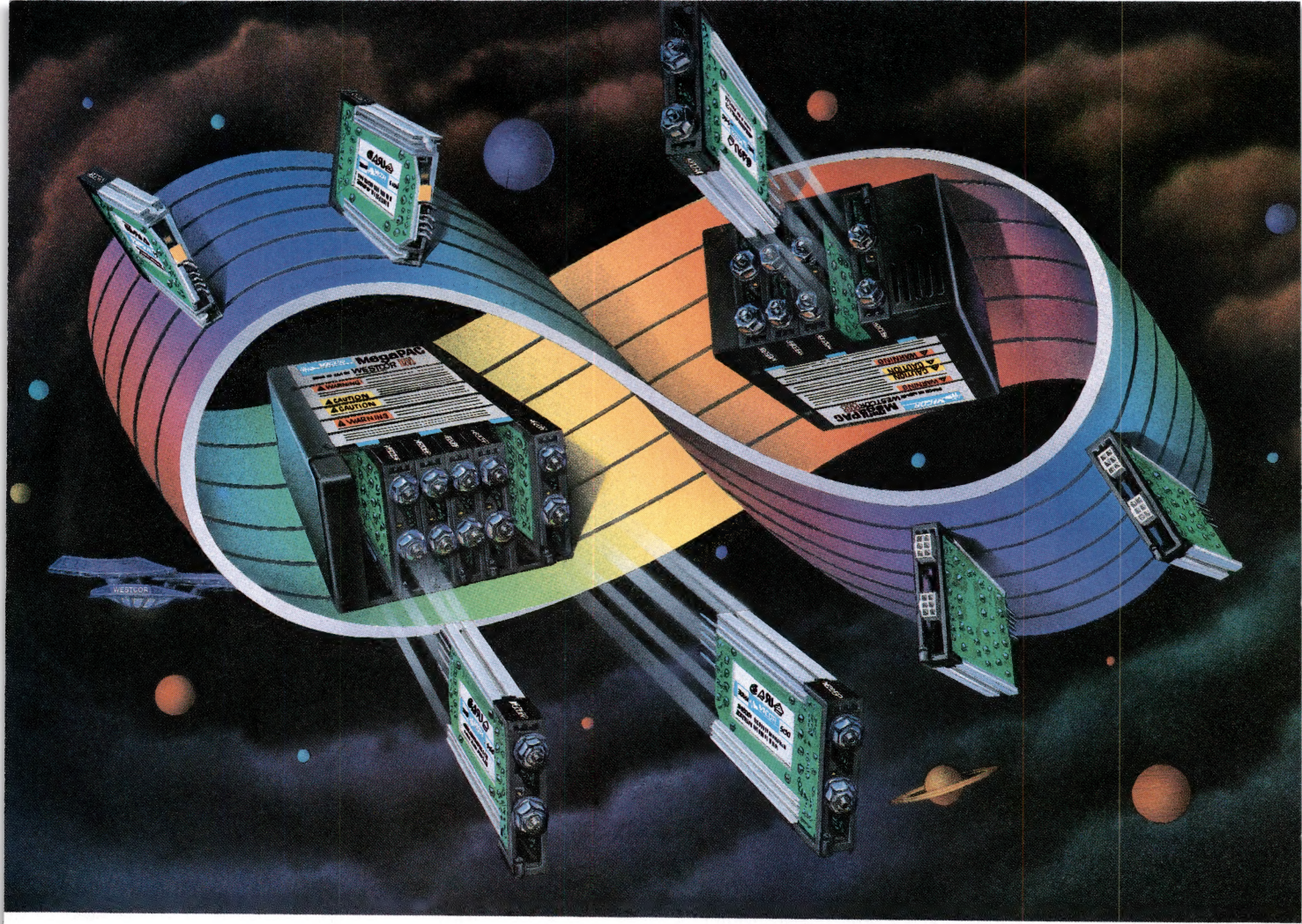

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Your opportunities are endless to mix and match MegaPAC options. And with so many possible power solutions available, you can define one precisely to fit *your* needs.

But MegaPAC flexibility doesn't end there. If your needs change, so can your switcher …which gives you another reason to choose MegaPAC power supplies: they're *the only field-configurable power supplies* on the market. To alter voltage or power levels on site, just loosen a screw, slide out a ModuPAC converter assembly, and slide in a new one. It's that simple.

Take a look at our new additions to the MegaPAC family, highlighted at right.

For details about MegaPAC switching power supplies, call Vicor Express at 800-735-6200 or Vicor's Westcor Division at 408-522-5280 (FAX 408-774-5555).

### Size Options

- **MegaPAC**—8 ModuPAC slots 11.8"L x 6.0"W x 3.4"H
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### Input Options

- 120/240 VAC strappable
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- 85-264 VAC universal input with power factor correction ***NEW! Meets IEC 555.***

### Output Options

- Up to 1600 watts total
- Up to 100 or up to 200 watts per output
- 1-16 outputs, isolated & fully regulated
- 1 to 95 VDC

***ModuPAC slide-in converter assemblies:***

- Standard—one output, up to 200 watts
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- ***NEW* RamPAC™**—for very low noise
- ***NEW* VXI Option**—for low noise and low ripple to meet instrumentation standard VXI

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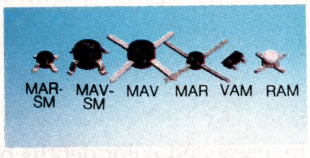


Models above shown actual size

from **99¢** Unit price $ (25 qty)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| PLASTIC SURFACE-MOUNT | | | ++VAM-3 1.45 | | +VAM-6 1.29 | ++VAM-7 1.75 | | |
| add suffix SM to model no. (ex. MAR-1SM) | MAR-1 1.04 | MAR-2 1.40 | MAR-3 1.50 | MAR-4 1.60 | MAR-6 1.34 | MAR-7 1.80 | MAR-8 1.75 | |
| | MAV-1 1.15 | +MAV-2 1.45 | +MAV-3 1.55 | MAV-4 1.65 | | | | MAV-11 2.15 |
| CERAMIC SURFACE-MOUNT | RAM-1 4.95 | RAM-2 4.95 | RAM-3 4.95 | RAM-4 4.95 | RAM-6 4.95 | RAM-7 4.95 | RAM-8 4.95 | |
| PLASTIC FLAT-PACK | MAV-1 1.10 | +MAV-2 1.40 | +MAV-3 1.50 | +MAV-4 1.60 | | | | MAV-11 2.10 |
| | MAR-1 0.99 | MAR-2 1.35 | MAR-3 1.45 | MAR-4 1.55 | MAR-6 1.29 | MAR-7 1.75 | MAR-8 1.70 | |
| Freq.MHz,DC to | 1000 | 2000 | 2000 | 1000 | 2000 | 2000 | 1000 | 1000 |
| Gain, dB at 100MHz | 18.5 | 12.5 | 12.5 | 8.3 | 20 | 13.5 | 32.5 | 12.7 |
| Output Pwr. +dBm | 1.5 | 4.5 | 10.0 | 12.5 | 2.0 | 5.5 | 12.5 | 17.5 |
| NF, dB | 5.5 | 6.5 | 6.0 | 6.5 | 3.0 | 5.0 | 3.3 | 3.6 |

Notes: + Frequency range DC-1500MHz ++ Gain 1/2 dB less than shown

designer's amplifier kits
***DAK-2:*** 5 of each MAR-model (35 pcs), only $59.95
***DAK-2SM:*** 5 of each MAR-SM model (35 pcs) only $61.95
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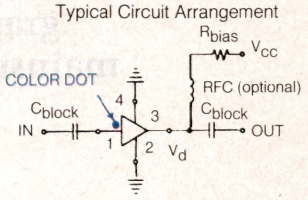
designer's chip capacitor kit
***KCAP-1:*** 50 of 17 values, 10pf to 0.1μf (850 pc), $99.95

chip coupling capacitors at .12¢ each (50 min.)

| Size (mils) | Value |
|---|---|
| 80 x 50 | 10, 22, 47, 68, 100, 220, 470, 680 pf |
| 80 x 50 | 1000, 2200, 4700, 6800, 10,000 pf |
| 120 x 60 | .022, .047, .068, .1μf |

Typical Circuit Arrangement

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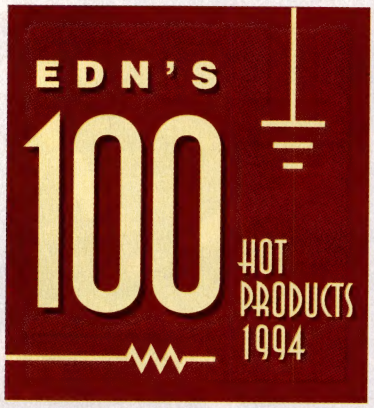
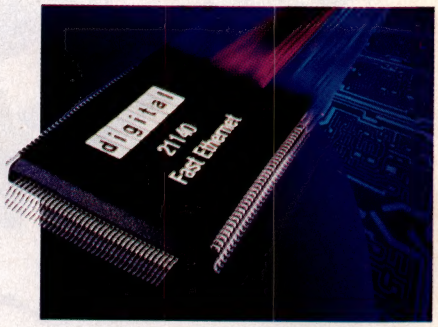






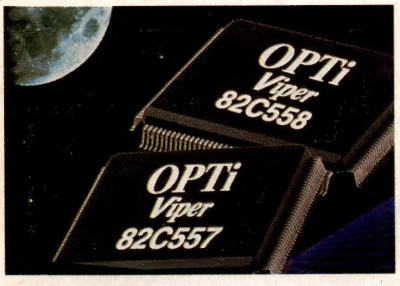







**EDN** | **DESIGN FEATURES**

## OUT IN FRONT








## EDN | DESIGN IDEAS



## EDN | PRODUCTS



## EDN | DEPARTMENTS



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|---|---|---|---|---|---|---|---|
| | | GVGC450/453 | GVGC650/650L | GVSC450 | GVS470 | GVSC653 | GVSC670 |
| Process | | 0.8 micron CMOS | 0.6 micron CMOS | 0.8 micron CMOS | 0.8 micron CMOS | 0.6 micron CMOS | 0.6 micron CMOS |
| Metal | | 2LM/3LM | 2LM/3LM | 2LM | 2LM | 2LM/3LM | 2LM |
| Usable Gate | | 2LM:4K to 133K<br>3LM:7K to 232K | 2LM:13K to 260K<br>3LM:22K to 500K | up to 300K | up to 350K | up to 780K | up to 1,110K |
| Pad Count | | 80 to 434 | 104 to 524 | up to 444 | up to 444 | up to 524 | up to 524 |
| Number Of Base Array | | 16 | 24 | – | – | – | – |
| Operating Voltage | | 5V | 3.3V/5V | 3.3V/5V | | 3.3V/5V | |
| Gate Delay (Fan out=2) | | 205PS | 5V : 130PS<br>3.3V : 180 PS | 190 PS | 195 PS | 5V : 160 PS<br>3.3V : 220 PS | 5V : 193 PS<br>3.3V : 266 PS |
| Toggle Freq. | | 360 MHz | 690 MHz | 340 MHz | 330 MHz | 640 MHz | 490 MHz |
| Power Consumption | | 3.7μW/gate/MHz | 5V:3.6μW/gate/MHz<br>3.3V:1.3μW/gate/MHz | 3.4μW/gate/MHz | 1.9μW/gate/MHz | 2.7μW/gate/MHz | 0.6μW/gate/MHz |
| Output Drive (mA) | | 2,4,8 or 12 | 2,4,8,12 or 24 | 2,4,8,12 or 24 | | 2,4,8,12 or 24 | |
| ROM | Max.bit Size | 32K | 128K | 128K | | 128K | |
| RAM | Max.bit Size | 64K | 128K | 128K | | 128K | |

*0.5 micron will be available from the 2nd quarter of 1995.

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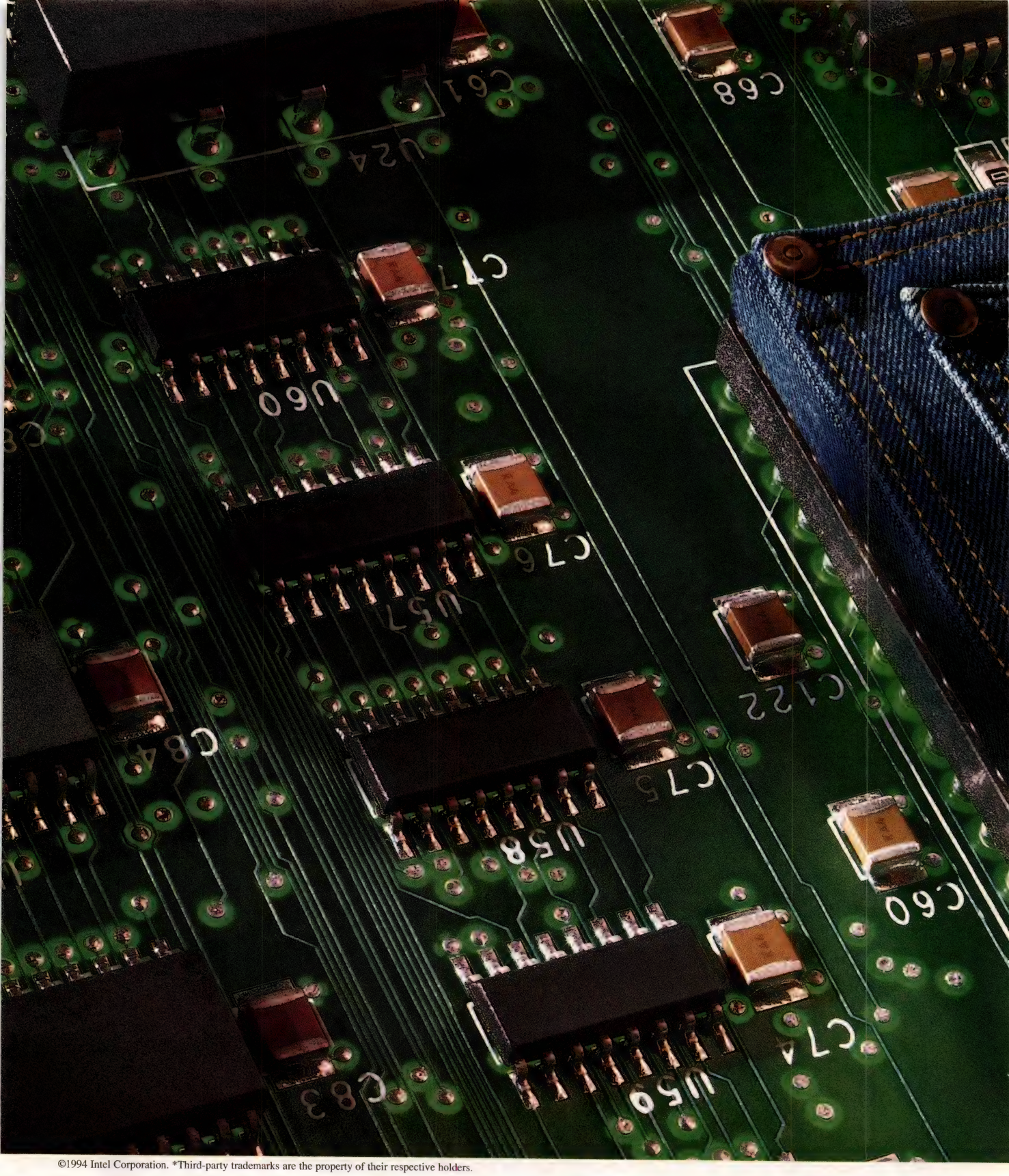




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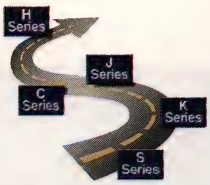


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*Plastics Business Group*

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CIRCLE NO. 33

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## Chip set connects Pentium μPs to PCI bus

The Viper core-logic chip set from Opti bridges Pentium and Pentium-class μPs to the Peripheral Component Interconnect (PCI) bus. The device supports single and dual μPs and comprises three chips: a system controller in a 208-pin PQFP; an integrated peripheral controller in a 208-pin PQFP; and a data buffer in a 160-pin PQFP.

The chip set operates with all Pentium systems and the soon-to-be released Pentium-class μPs from American Micro Devices (K5) and Cyrix (M1). The device handles the write-back cache feature for L1 caches in high-performance μPs and supports asynchronous cache, synchronous cache, pipelined burst, and third-party integrated cache controllers. In addition, Viper supports L2 cache with an adaptive write-back controller. Viper handles 3.3 and 5V μPs.

Opti also announced the 82C621 PCI IDE-controller chip that handles master-mode IDE as well as ANSI Modes 4 and 5. The 82C621 offers a dual pipeline, so that simultaneous transfers can occur to two separate IDE drives.

The Viper chip set costs $30; the 82C621 costs $5 (OEM quantities).—by John Gallant

**Opti Inc**, Santa Clara, CA, (408) 980-8178.

**Circle No. 345**


**The Viper chip set from Opti Inc bridges Pentium-class μPs to the PCI bus.**

## Monolithic ADC leaps into hybrid territory

**A new ADC from Analog Devices combines a high-speed bipolar/CMOS process and a novel architecture to achieve the resolution and speed of hybrid ADCs at as little as one-fourth the cost and power consumption. The 14-bit, 2.2M-sample/sec AD878 typically consumes 550 mW at 5V and costs $75 (1000). The ADC, which includes an S/H amplifier and a voltage reference, uses a multistage pipelined architecture with factory-programmed calibration circuitry and output-error-correction logic to achieve its combination of accuracy and sampling rate. Other key typical specifications include an S/N ratio plus distortion of 76 dB (for 100-kHz inputs), a spurious-free dynamic range of 88 dB (for 100-kHz inputs), a differential-nonlinearity error of 0.5 LSB, and a guarantee of no missing codes. The input S/H amplifier can switch negative-to-positive, full-scale voltage levels and can handle single-channel inputs at Nyquist frequencies. A single input controls all internal conversion cycles, and output data is in binary format. Primary applications include communications, such as ADSL, and imaging. Production quantities of the device in a 44-pin PLCC surface-mount package will be available next month.**

**—by Anne Watson Swager**

**Analog Devices, Wilmington, MA, (617) 937-1428. Circle No. 346**

## Merged EDA tools speed deep-submicron ASIC design

A new electronic-design-automation (EDA) tool from Cadence, dubbed Silicon Synthesis, merges ASIC placement and synthesis into one step, eliminating time-consuming iterations in the design of deep-submicron (smaller than 0.5-μm) ASICs. The tool gives front-end logic designers added control of traditional back-end, or physical, implementation issues early in the design cycle, enabling more timely correction of timing problems and loading violations.

Front-end knowledge of placement information is essential to successful deep-submicron design, according to Cadence, primarily because of the increased effects of interconnect delays relative to gate delays. Because larger dies in deep-submicron designs

*(continued on pg 20)*

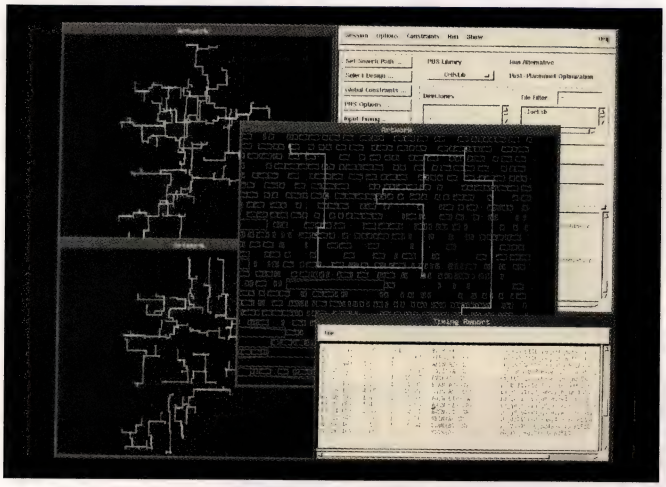
result in longer wires, interconnect delays account for perhaps 80% of total delay, with gate delays contributing only 20%. Traditional design tools, using separate steps for synthesis and placement, too often yield postlayout delay results that differ significantly from prelayout estimates, requiring multiple design iterations.

Silicon Synthesis speeds design in two ways. First, according to Cadence, it provides more accurate estimates of interconnect delays than those from conventional tools. Consequently, postlayout delays don't differ dramatically from prelayout estimates, and, as a result, the correction of timing problems doesn't require major front-end modifications. Second, a fast placement tool, Q Place, speeds design iterations. Cadence claims Q Place is 10 to 50 times faster than conventional placement engines.

Silicon Synthesis is available now to "selected partners," according to Cadence. It will be more broadly available in the first half of 1995 for about $90,000.—by Gary Legg

**Cadence Design Systems Inc**, San Jose, CA, (408) 943-1234.

**Circle No. 347**



**Cadence's Silicon Synthesis combines fast placement with an advanced timing algorithm to effectively merge the logical and physical components of deep-submicron ASIC design.**

## FPGA family targets low-end gate-array market

With its XC5000 family of field-programmable gate arrays (FPGAs), Xilinx hopes to capture the low-end gate-array market from manufacturers that are shifting their focus to higher volume, higher density applications. For designs of 20,000 gates or fewer, the family provides shorter time to market and the affordability of gate arrays. It also provides reprogrammability and off-the-shelf availability of a standard part.

The XC5000 family employs an SRAM-based architecture that combines three-layer metallization and 0.6-µm CMOS technology. Key innovations include VersaBlock logic modules and the VersaRing I/O interface. The logic modules combine logic and routing resources to provide a symmetrical, granular architecture that lets you transfer designs in a segmented and hierarchical fashion, which maximizes logic usage. The I/O interface decou-

*(continued on pg 22)*

## Alliance to license wireless LAN system

**GEC Plessey Semiconductors (GPS) and Apple Computer have jointly developed a wireless communications system for portable and desktop applications. The partners intend to license the system for integration with networks. The alliance combines GPS' expertise in RF and microwave technology with Apple's strength in system design. The base of the system, the 2.4- to 2.5-GHz GPS DE6003 wireless transceiver module, employs spread-spectrum, frequency-hopping technology. The LAN costs $225 (10,000).—by John Gallant**

**Apple Computer Inc**, Cupertino, CA (408) 974-3078. **Circle No. 348**

**GEC Plessey Semiconductors Inc**, Scotts Valley, CA, (408) 439-6049. **Circle No. 349**

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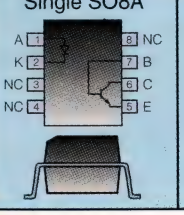
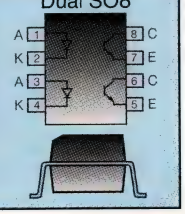



Dual SO8

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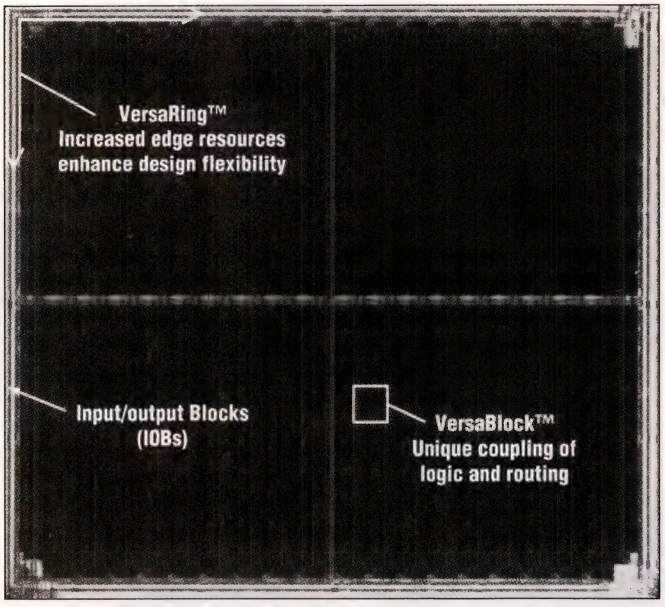
**CIRCLE NO. 146**

ples the I/O blocks from the core logic and adds incremental routing resources along the edge of the device. This allows you to place logic in the device without the constraint of limited edge routing.

A 10,000-gate XC5210 provides 40-MHz system-level performance and offers as many as 1296 flip-flops and 192 I/O pins. Price is $39.—by John Gallant

**Xilinx Inc**, San Jose, CA, (408) 559-7778.

**Circle No. 350**




**The Xilinx XC5000 FPGA family features a versatile interface, called VersaRing, between the internal logic and I/O blocks to decouple the I/O blocks from the core logic.**

## Equipment will help PCS-auction winners recoup investments

It isn't clear which technology will emerge as the winner in the new 1.8- to 2-GHz Personal Communications Services (PCS) band, whose frequencies the FCC is auctioning this month. However, the DCS 1900 Digital Communications Services standard, which uses the Global System for Mobile Communications (GSM) protocol, is a top contender. One reason for DCS 1900's position is the high level of development of GSM communications in Europe. Because GSM has been in place there for five years, its users know the system's strengths and weaknesses and have worked out most of its kinks. Equipment to test GSM phones and base stations is available. System operators who choose DCS 1900 will be able to get on the air rapidly, so that they can begin recouping their investment in spectrum space.

Rohde & Schwarz, a leading supplier of GSM-test equipment to European customers, intends to capitalize on that position when it sells to US mobile-phone-system manufacturers and system operators. To add muscle to its US marketing effort, Rohde & Schwarz has joined forces with Tektronix. The two companies are offering five products to serve both US and worldwide markets: the CMD55 mobile-phone test set ($28,440 with options priced from $195 to $3095), the CMD57 base-station test set ($32,800 with options priced from

*(continued on pg 24)*

## Universal calibration system supports ISO 9000 compliance

**A universal calibration system from Wavetek helps you maintain an inventory-management system to audit the calibration status of your test instruments—a key requirement of ISO 9000. In addition, the device lets you meet that requirement on-site and with a minimum of fuss.**

**The 9100 system comprises a self-contained multifunction calibration source, PC-based software, and around 350 calibration procedures programmed into PCMCIA cards. For a simple system, insert a PCMCIA card into the calibrator's front panel and take a 5-minute guided tour through a calibration procedure. For a complex system, link the calibrator to a PC and use the system's inventory-management system to control calibration records, schedules, and analysis for an unlimited number of instruments. The system outputs custom calibration reports and certificates and lets you develop additional PCMCIA-card procedures.**

**A standard 9100 enables you to calibrate a wide range of instruments, including handheld, panel, and benchtop DMMs; analog and clamp meters; power analyzers; electronic thermometers; chart recorders; and data loggers. By adding options, you can also calibrate oscilloscopes and counter/timers.**

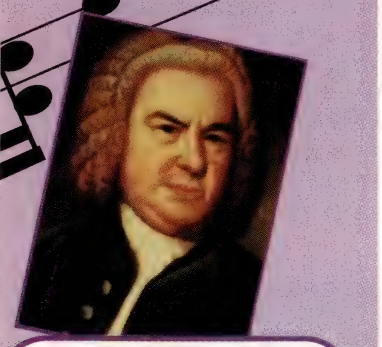
**Key outputs include dc or ac voltage to 1050V, dc or ac current to 20A, resistance to 400 MΩ, capacitance to 40 mF, and conductance to 2.5 mS. Other sources include synthesized sine, square, triangle, impulse, and trapezoidal waveforms. The calibrator also outputs variable-amplitude pulses to 100 MHz, variable-duty-cycle pulse widths to 2 sec, and other waveforms to calibrate 250-MHz oscilloscopes.**

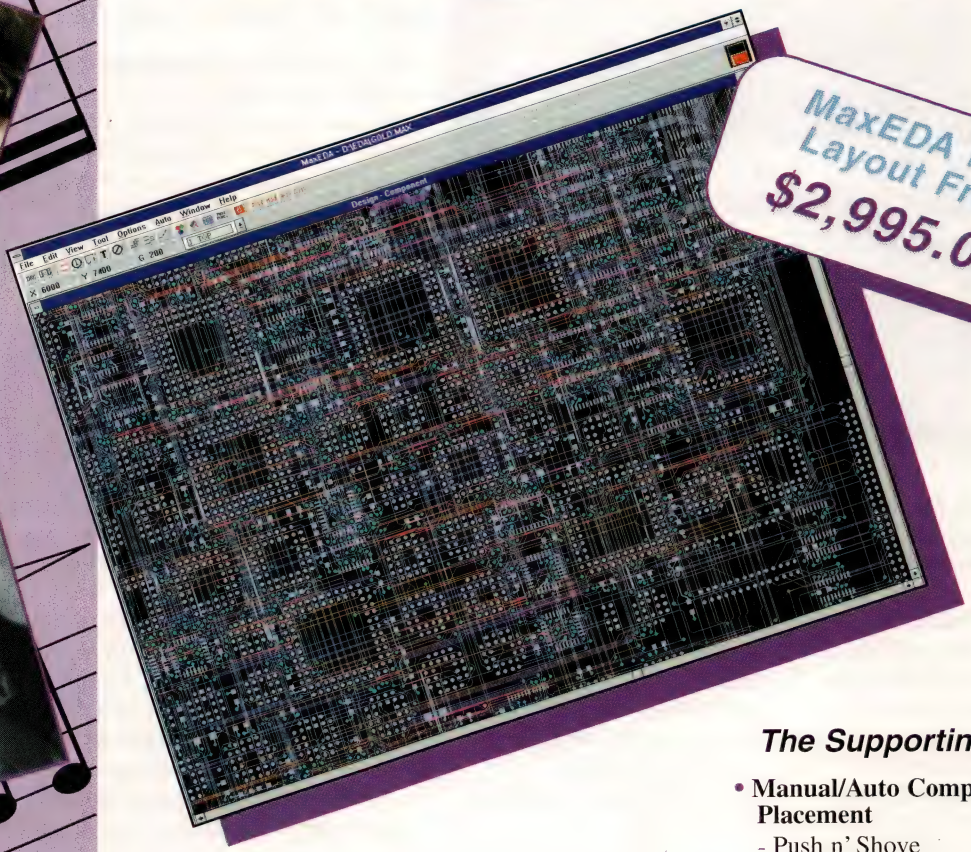
**Although the device is self-contained, its ac-power limits are 1050V at 10 kHz, 350V at 30 kHz, and 20A at 10 kHz. A typical system configuration costs $15,000.**

**—by Brian Kerridge**

**Wavetek Calibration Division, Norwich, UK, (44) 1603-404824. Circle No. 351**

# A Moving Performance!





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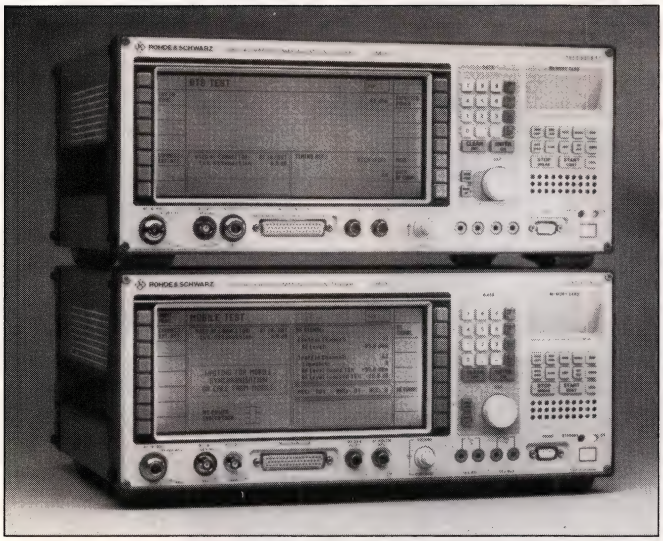

**These test sets for mobile phones and base stations help system manufacturers and operators who adopt the DCS 1900 PCS standard.**

$195 to $10625), the CRTP02 mobile-phone test system (from $238,700), the CRTP04 base-station test system (from $276,600), and the CRTP24 mobile/base-station test system (from $300,750). Delivery for all is 12 weeks ARO.

The two companies aren't placing all their bets on DCS 1900, however. They intend to achieve the same market-leadership position that Rohde & Schwarz enjoys in Europe, regardless of which PCS technology ultimately wins. In other words, stay tuned for further announcements in coming months.

—by Dan Strassberg

**Rohde & Schwarz Inc**, Lanham, MD, (301) 459-8800. **Circle No. 352**

**Tektronix Inc**, Beaverton, OR, (800) 426-2200. **Circle No. 353**

## PowerPC port boosts Windows NT 3.5 performance

Motorola's port of the Windows NT 3.5 operating system to the company's PowerPC RISC systems provides a faster Novell Internetwork Package Exchange stack and better support for Transfer Control Protocol/Internet Protocol than does Windows NT 3.1. The new version, formerly called Daytona, also requires 4 to 8 Mbytes less RAM than the previous version and includes Microsoft's compatible-workstation service and a NetWare-compatible gateway. Motorola offers a software developer's kit for the product that includes a C/C++ compiler that lets developers compile and execute programs on one PowerPC machine. The company also offers firmware and hardware kits. Prices for the development tools start at $195; the software developer's kit costs $495.—by Fran Granville

**Motorola Inc**, RISC Microprocessor Division, Austin, TX, (800) 845-6686. **Circle No. 355**

## *Single-mask gate arrays allow fast-turnaround, low-volume ASICs*

***The OneMask gate-array family from Chip Express enables high-density (up to 45,000 gates), high-speed ASICs to be cost-effective in production volumes as low as 10 units per shipment. The gate arrays use the company's proprietary single-mask, single-etch wafer-fabrication process. The family uses the same wafer and layout as the company's laser-programmable gate-array (LPGA) family, easing transition from laser prototyping to initial production.***

***The company's minifab process allows production of single wafers and achieves 10-day delivery of up to 5000 pieces or scheduled deliveries of just hundreds of units per month. Conventional gate-array vendors typically have a minimum-order requirements of 5000 pieces; Chip Express requires a 10-unit minimum quantity for a single OneMask shipment. In addition, OneMask enables low-volume users to achieve the density of conventional masked gate arrays without paying high NRE costs.***

***OneMask technology customizes one wafer at a time in contrast to LPGA technology, which customizes one die at a time. OneMask personalizes a two-layer CMOS gate array with a single mask employing a single etch. The base array is metallized at the foundry, and the generic base wafers are inventoried in the minifab.***

***Although Chip Express initially targeted the gate arrays for prototyping preproduction, OneMask's rapid turnaround qualifies it for production shipments. A "flowable-nitride" passivation process enables the severe topography of a single-mask, etched wafer to receive an even layer of passivation.***

***Devices using OneMask technology are available in 1.2- and 0.8-μm CMOS geometries. Unit price for a 20,000-gate array (QYH520) in an 84-pin PLCC package are $171 (100) and $24 (5000).—by John Gallant***

***Chip Express**, Santa Clara, CA, (408) 988-2449.* ***Circle No. 354***

## 68306 μP powers digital set-top box

Motorola's 68306 μP provides the processing power for Tee-Comm's new StarTrak digital integrated receiver decoder (IRD). The 68306 comprises the EC000 core processor, a 6868 UART, a DRAM controller, and system glue logic. The μP suits set-top boxes requiring short design time, little space, and low power consumption.

Tee-Comm combines the 68306 with digital video compression to produce a 24-in.-diameter satellite dish, which will soon make 4- to 6-ft-diameter dishes obsolete, according to the company. StarTrak initially features 85 channels but will offer 120 channels as acceptance for the product grows. The IRD also includes an internal telephone modem, an RS-232C data port, a seven-day program guide, MPEG-2 decoding, power consumption of less than 30W, and the ability to load

*(continued on pg 26)*

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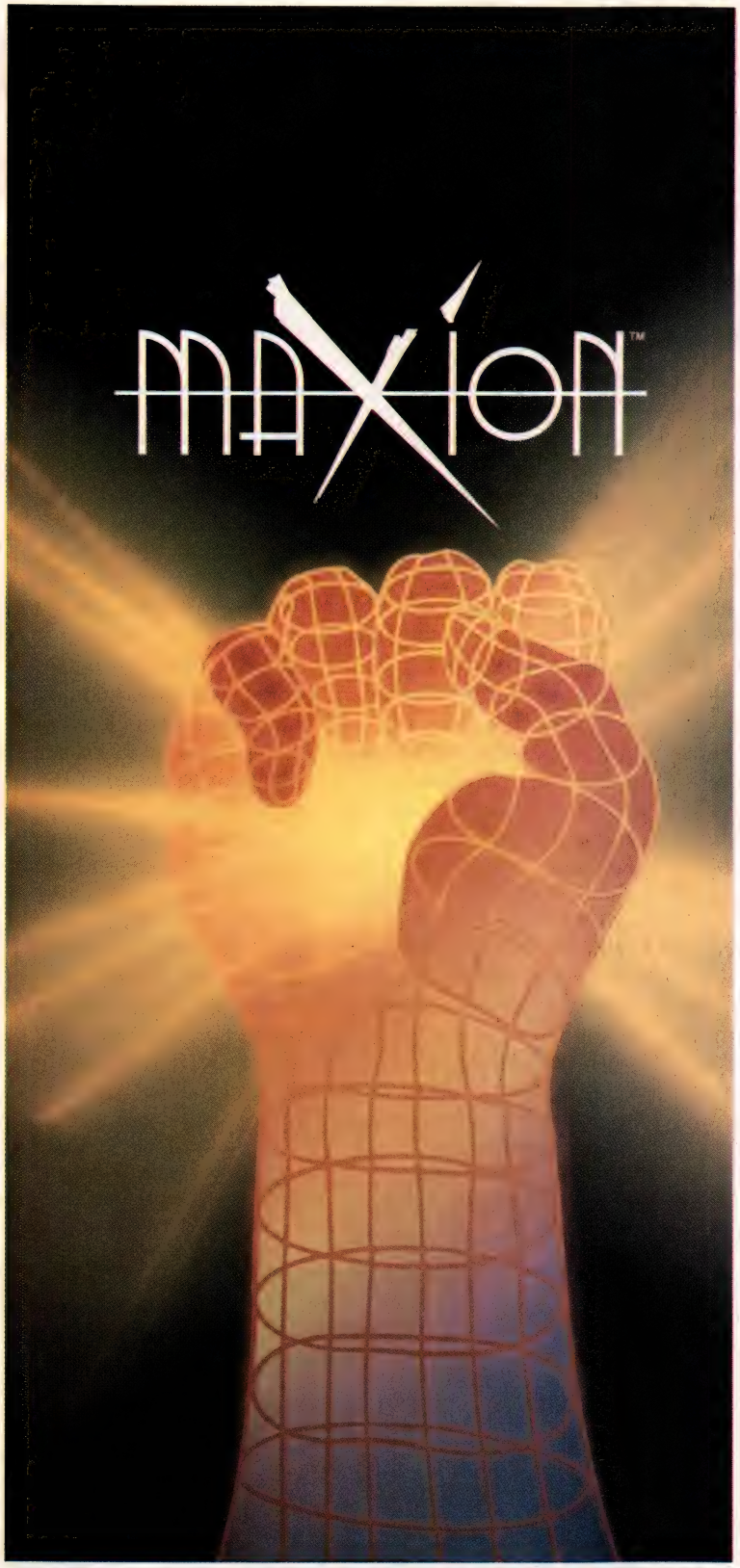


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the configuration and software for the receiver at any time through the satellite network.

StarTrak will available in the United States next year. Price is $799, including the satellite antenna and receiver.—by Fran Granville

**Motorola**, High Performance Systems Division, Austin, TX, (416) 756-5270. **Circle No. 356**

**Tee-Comm Electronics Inc,** Milton, ON, Canada, (905) 878-08181. **Circle No. 359**

## SOFTWARE REVIEW

# File Manager add-on takes the pain out of Windows

To put it mildly, some of us are less than ecstatic about Microsoft Windows. But, until a few months ago, when Beta testers began receiving their copies of Windows 95 (the 32-bit version of Windows that used to be code-named Chicago), criticism of Windows V3.1 was not sanctioned in $(PC)^2$ circles. ($(PC)^2$ stands for "politically correct personal computing.") Now that Windows 95 is on the horizon—even if the horizon keeps receding—criticism of Windows 3.1 has become more acceptable.

Well, there's good news for those of you who can't stand the Windows user interface, who don't want to wait for Windows 95 (or are unimpressed by the user-interface improvements it allegedly contains), or who feel that they have no alternative to using one of the current versions of Windows. The good news is Mijenix's WizManager V2.0 Windows add-on, which is available only by mail ($39.95 plus $5 for shipping). WizManager largely does away with the need to interact with one of the more inane and senseless parts of Windows—the Program Manager.

The software modifies the File Manager to improve it and to allow it to replace the Program Manager. The product adds customizable button and launch bars to the top of the File Manager screen and lets you set up buttons on the launch bar to start your favorite applications. If you frequently use more applications than can be displayed in a single row of launch-bar buttons (13 at a screen resolution of 640×480 pixels), the launch bar scrolls horizontally.

Windows provides several ways to switch among running applications, but I don't find any of them satisfactory. Of the ways that are native to Windows, I find the Task List, which you access by holding down the Control key and then pressing the Escape key or by double-clicking anywhere on the Desktop, to be best of a sorry lot.

WizManager reduces the number of keystrokes or mouse moves and clicks that Task List requires for selecting an application. If you click the right mouse button anywhere on the WizManager screen except on the launch or button bars, a drop-down menu appears. Among other items, this menu lists all open applications alphabetically. Contrast this with the Task List, which lists the current application first followed in reverse chronological order by the most recently used applications. WizManager lets you return to any application with a single click or by typing the number that appears to the left of the application name. If you have more than nine applications open, selecting some applications via the keyboard requires using an arrow key and the Enter key.

Using WizManager, you can print directories, trees, and the results of File Manager searches. You can also save these items to ASCII files on disk without setting up Windows' "print-to-disk" facility. An extended search facility lets you list duplicate files that have different names and files containing designated text strings. However, you cannot print or save the results of these extended searches, except with the Windows Clipboard. Mijenix promises to correct this deficiency in a future release.

Those who prefer a command-line interface can issue any of a long list of WizManager commands, many of which mimic DOS commands, without "shelling out" of Windows. Just place the cursor in a little window near the launch bar and type your command. You can access any *real* DOS command by typing an equals sign before its name. Typing the name of an executable DOS program takes you immediately to DOS in full-screen mode. There's no need to set up a Program Manager program-item icon or to type "exit" after the program has executed.

With Windows 95 on the way, even the modest price of this package may seem extravagant. But Mijenix promises that, contrary to what you may have heard, the new operating system will leave a place for software of this type. Moreover, future implementations will use true 32-bit code and will be compatible both with Windows 95 and Windows NT. Thus, an investment in the current 16-bit version is unlikely to be wasted, as Mijenix is almost certain to offer current registered users an opportunity to upgrade.

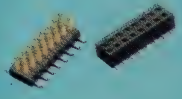
—by Dan Strassberg

**Mijenix Corp**, Madison, WI. (608) 277-1971. **Circle No. 357**

**Video gives ISO 9000 basics.** "Employee Intro to ISO 9000" educates direct-manufacturing and service employees in companies that want to acquire ISO 9000 certification. The video emphasizes the importance of registering for ISO 9000, a process that requires employee cooperation. The 12-minute video explains what ISO 9000 standards are and how the certification affects companies and employees. It also covers how employees should handle ISO auditors. $129. **The Media Group**, Williston, VT, (800) 678-1003. **Circle No. 358**

# SAMTEC VIRTUAL INTERCONNECTS

(actual size)



## So small they're virtually invisible.

Samtec 050" pitch surface mount and micro interconnects provide high-speed, impedance matched connections in minimal space. In fact, if you couldn't see them, you would hardly know they were there. Just the way interconnects should be.

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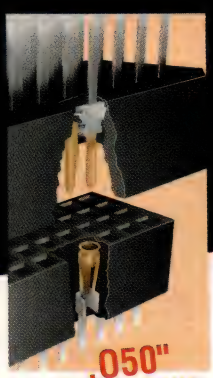

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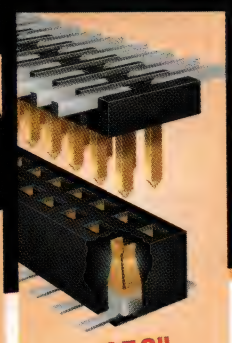

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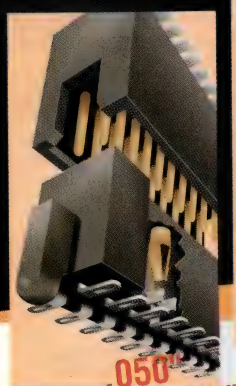

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CIRCLE NO. 139

**Coverage of lowpass EMI filters.** This 64-pg catalog details a line of EMI filters, including miniature solder-in, solder-in, and high-current/high-voltage resin-sealed types. It features specification information on capacitive and inductive elements, various circuit configurations, insertion-loss measurement, and the relationship between circuit impedance and insertion loss. **Spectrum Control**, Fairview, PA. **Circle No. 387**


**Catalog features test equipment, tools, and supplies.** This 48-pg guide describes test instruments and tools for design engineers. Product highlights include programmable power supplies, DMM and scope accessories, spectrum analyzers, frequency analyzers and counters, and EPROM programmers. **Contact East Inc**, North Andover, MA. **Circle No. 388**

**Catalog for in-line inspection.** *Measurement Sensors* features displacement, inspection, and measurement sensors for in-line applications. The 152-pg catalog provides a selection guide and information on a range of applications and covers accessories such as laser safety kits and intelligent panel meters. **Omron Electronics Inc**, Schaumburg, IL. **Circle No. 389**

**Learn about LEDs.** A 48-pg LED product guide includes maximum ratings, optoelectrical characteristics, and mechanicals for blinking, packaged, axial-leaded, and surface-mount LEDs. **Marktech International**, Lantham, NY. **Circle No. 390**

**Parts list tracks IEEE-1149.1 growth.** The *1149.1 ChampionChip List* is a compilation of IEEE-1149.1-compliant parts. The free brochure contains three sections that detail the changes in vendors and products between 1993 and 1994 for ASICs, catalog, and programmable ICs. **Alpine Image Systems Inc**, Mountain View, CA. **Circle No. 391**

**Products for PC cards covered.** Information on a line of PCMCIA-compatible cables, card-frame kits, and headers for type I and II PC cards is included in this 20-pg catalog. The product-selection guide contains PC-card information, PCMCIA-card technology, frame-kit specifications, and board layouts. **Methode Electronics Inc**, Chicago, IL. **Circle No. 392**

**Win-30 and LabView technical-reference manual.** *Using the Win-30 with LabView* is a 75-pg guide detailing a line of PC-based data-acquisition boards under LabView. The catalog describes the functions supported, including waveform acquisition (analog input), analog output, and digital I/O. **United Electronics Industries**, Watertown, MA. **Circle No. 393**

# Get The Edge in ASIC

Technology leadership is our business - and it shows.

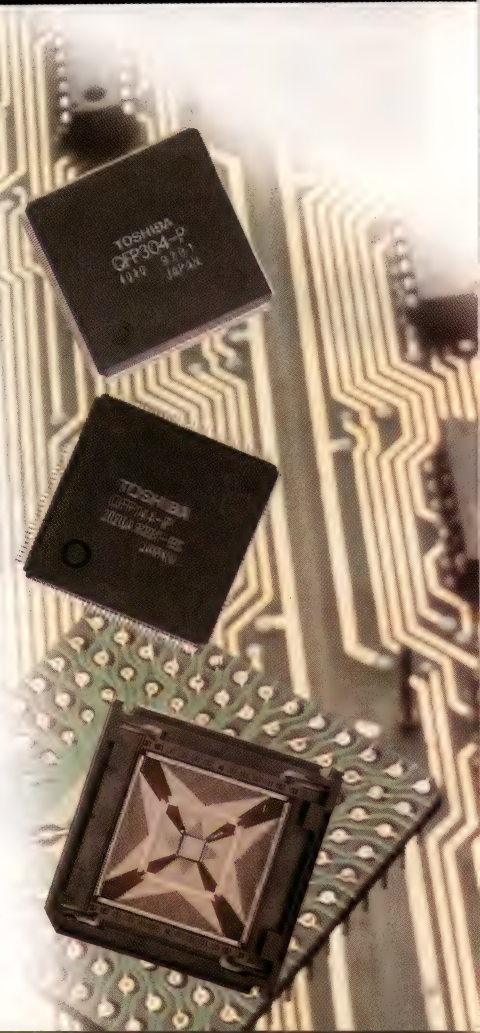
Toshiba extends the frontiers of innovation in ASIC, with usable, high reliability solutions offering the optimum performance/price ratio for your needs.

0.5 micron 560K Gate Arrays, Standard Cell and Embedded Arrays are available in many configurations including a 3V core with selectable active output buffers to interface to 5V components. System solutions incorporating µC, EEPROM and analogue functions are possible.

The package range includes low profile PFPs, lead spacing down to 0.4mm with 300-plus leads and heat spreader packages offering ceramic thermal performance at lower cost. In addition, new packages such as Ball Grid Arrays are currently under development.

There's local engineering support from European design centres to tailor these technologies to your application, and interface with prototyping and production facilities.

That's why when you specify Toshiba ASICs, you automatically build in a competitive advantage.




**CIRCLE NO. 160**

In Touch with Tomorrow

**TOSHIBA**

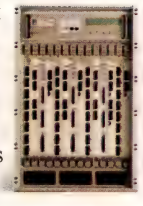
# WHEN YOU'RE OUT ON THE LEADING EDGE OF TECHNOLOGY, WHERE DO YOU GO FOR PARTS?

Let's face it—even the most out-of-this-world projects have to start someplace.

And according to major players in telecommunications, computer technology, broadcast and multimedia, the best place to start is with Xilinx programmable logic.

*Obviously, Northern Telecom likes to keep people in touch—the impetus behind their advanced Companion Base Station. This product delivers the promise of wireless communications to virtually any workplace. But guess who got the call when they built it? Xilinx, that's who. So, I suppose you could say that we like to keep people in touch, too.*

What do they know that you don't? Well, first, Xilinx FPGAs save you time. With our parts, you can make design changes quickly and easily. We're talking in terms of days and hours here—instead of the months you'd wait for conventional gate arrays. In essence, this gives you a better shot at being first to market—and you know what an advantage



*When Cabletron built their MMAC-PLUS switching hub, they went with Xilinx. Why? Fast time-to-market, support for VHDL/Synthesis and world-class technical know-how. The results: another market-leading product for Cabletron. And 25 new design wins for Xilinx.*



that can be. Xilinx FPGAs also save you money.

Due largely to reduced geometries and improvements in our manufacturing process, we've dropped our prices by as much as 70% over the past year.

That's right—70%. But that's only the beginning.

Because when production really starts taking off, we can offer you further savings with our high-volume HardWire™ option.

These are our mask-programmed, easily-converted-right-from-your-FPGA-ready-for-production parts.

Unlike conventional gate array conversion, there's no customer engineering required.

No logic redesign.

No test vectors.

No re-simulation.

And no risk—Xilinx HardWire devices are fully guaranteed.

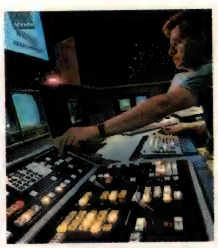
Should production throttle down again, or your product line suddenly change direction, you can simply return to the flexibility of our standard FPGAs.

All in all, convincing proof that Xilinx is the programmable logic of choice for today's hottest technologies.

And tomorrow's.

*The software is any movie ever made. The hardware is brought to you by Silicon Graphics® who chose high density, high speed FPGAs from Xilinx for the supporting role. The requirements for Silicon Graphics' ATM OC-3C Challenge board included high performance control and calculation logic, very little space, and an even tighter schedule. But that's show business in the age of video-on-demand.*

*These days, there's no hotter technology than Multimedia. And at the very core of this conflagration sits Orchid Technology. Their Vidiola Premium compression card sets the standard for others to follow. So how very fitting that they chose Xilinx FPGAs to help control the various operations of the board. Now Orchid can really put the heat on the competition.*



*The Hewlett Packard company doesn't create the television you watch. But their HPQA100 Quality Advisor, with an assist from Xilinx FPGAs, helps make that television better. How? By translating digital color information into high-quality broadcast signals. There. That ought to give you a nice, clear picture.*

So call us for more information at 1-800-231-3386 or fax us at 408-879-4780.

And start pushing the envelope with the future of programmable logic—Xilinx.

Because with our parts, even the sky isn't the limit anymore.

XILINX®

The Programmable Logic Company.℠

## Reader reports AND-gate inaccuracy

I just read "New philosophy aids shift from schematic-based to HDL-based design" (*EDN*, Aug 4, 1994, pg 119) by Charles F Shelor. On pg 119, Shelor cites a reference: "Looking at Fig 1, digital circuit designers will immediately recognize U1 as an AND gate, U2 and U4 as rising-edge-triggered D flip-flops, and U3 as an exclusive-OR gate."

The problem is that the gate referred to as U1 in the figure is not an AND gate but an OR gate. I understand that this circuit is for illustrative purposes only, but it should at least correlate with its text callout.

*Bob Trautman, Research Specialist*
*Lockheed Missiles & Space Co*

## Confusion-fears allayed

Thank you for SynaptiCAD's product coverage (*EDN*, September 1, 1994, pg 111). Unfortunately, we made a mistake in our press release, which may lead to confusion for your readers. The proper name of our product is *The* Timing Diagrammer, not Timing Diagrammer.

*Dan Notestein, President*
*SynaptiCAD Inc*
*Blacksburg, VA*

## Correct date, please

I'm writing to clarify a statement in the Electronic Design Automation product writeup, "PC-based electronic-design-automation-tool supplier moves to Windows" (*EDN*, September 1, 1994, pg 111).

The writeup states that "[OrCAD] expects the remainder of its tools to be available under Windows by year-end," which implies the end of this year. In fact, OrCAD's press release states that the tools will be available by the end of 1995. Unfortunately, this discrepancy has created premature demand for OrCAD's products.

*Jean E Armstrong*
*Alliance Consulting Group*
*Portland, OR*

## Clarification on Snap-Master source

I'd like to call attention to an error in "Visual programming pervades data-acquisition software development" (*EDN*, September 29, 1994, pg 63). Table 1 lists Analogic as the vendor for Snap-Master data-acquisition software. Although that company is one of many resellers of our software, HEM Data Corp is the author, developer, and manufacturer of Snap-Master.

In 1991, HEM Data introduced Snap-Master as the first data-acquisition software for Microsoft Windows and has just released a third generation, Snap-Master 3.0. Let your readers know of this clarification.

*Karen L Susalla, Marketing Manager*
*HEM Data Corp*
*Southfield, MI*
*(810) 559-5607,*
*fax (810) 559-8008*

## Dead batteries live on

I am somewhat confused by the closing statements in Charles Small's "Batteries explode into new applications and new chemistries" (EDN, October 13, 1994, pg 63). In describing the Evans Capbattery product, he states that other double-layer capacitor battery replacements "are no longer with us."

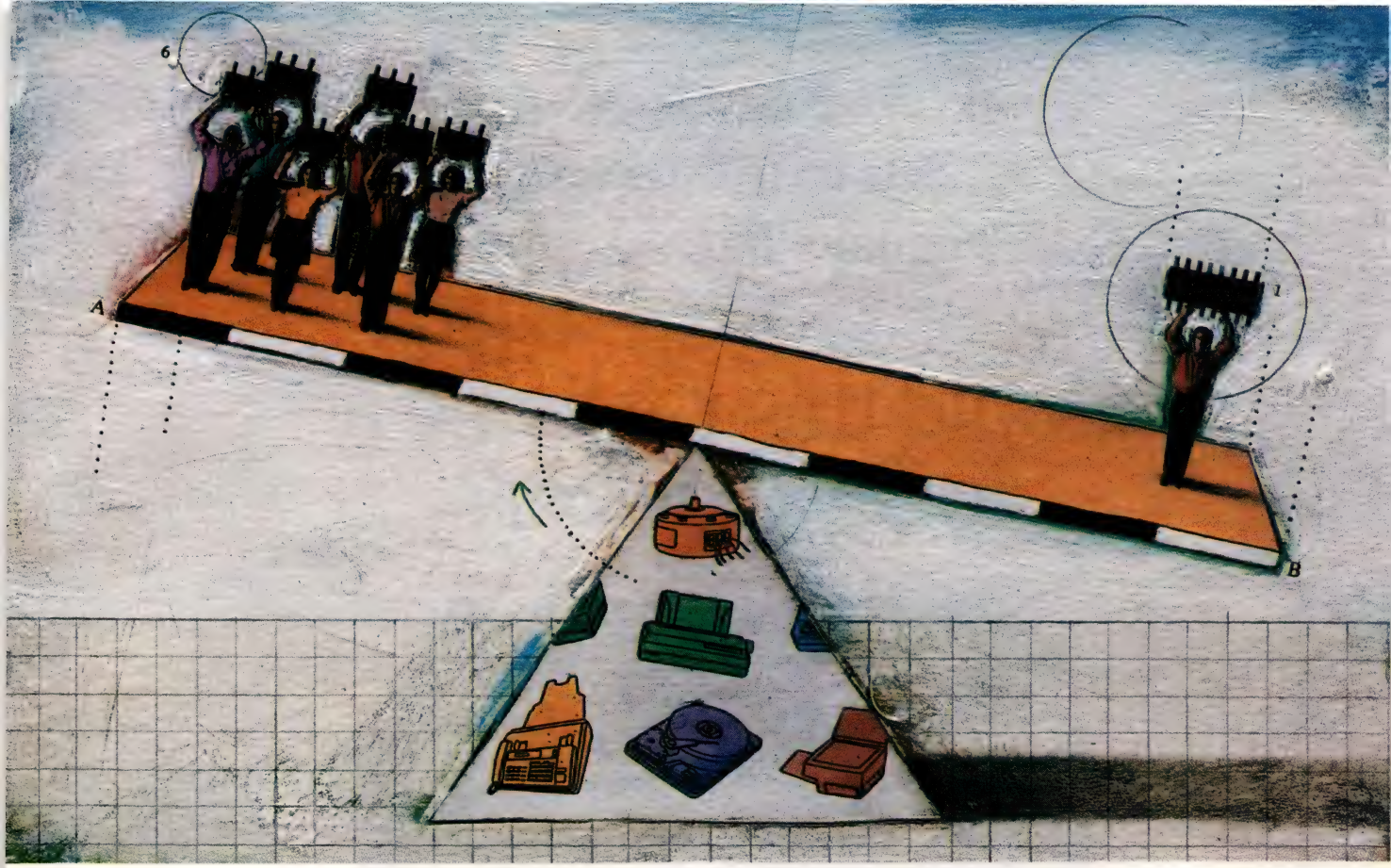
I can assure Mr Small that such capacitors continue to be readily available from several vendors. Components from NEC and Panasonic have been, and continue to be, very popular in the consumer/entertainment electronics field, where they have largely replaced batteries for memory backup.

I am certain that if Mr Small disassembled electronic products in his home he would find several of these components. For reference, the Evans product, as described in the article, seems to be essentially equivalent to NEC's Supercap, type number FA1A474Z (see *EEM* pg A-1122).

*Eric Kinast, Senior Engineer*
*Datascope Corp*
*Paramus, NJ*

## Sound off

Send your letters to Signals and Noise Editor, *EDN*, 275 Washington St, Newton, MA 02158. Or fax us at (617) 558-4470. *EDN* reserves the right to edit letters for clarity and length.



# Finally, a single-chip motor driver that gives you the leverage to outperform the competition.

Finally, a cost-effective, versatile way to drive fractional-horsepower motors from a single chip. It's the new generation of Power+ Arrays™ devices from Texas Instruments.

**Reduce your board space.** TI's Power+ Arrays are monolithic devices that integrate three, four or six power DMOS transistors into one surface-mount package. Meaning you don't need to worry about a multitude of discrete packages using up precious board space.

**Lower your system cost.** TI's Power+ Arrays devices are cost-effective alternatives to discrete power transistors and hybrids. In addition, a single-chip motor driver means fewer devices to insert, solder or test.

**Driver Descriptions**

| Device | Description | $r_{DS(on)}$ | $I_{MAX}$ | $I_{CONT}$ |
|---|---|---|---|---|
| TPIC2302 | Triple low side | 0.4 Ω | 5 A | 1 A |
| TPIC3302 | Triple high side | 0.4 Ω | 5 A | 1 A |
| TPIC5302 | Triple independent | 0.3 Ω | 7 A | 1.4 A |
| TPIC5404 | Full H-bridge | 0.3 Ω | 10 A | 1.7 A |
| TPIC5601 | 3-phase bridge | 0.3 Ω | 8 A | 1.7 A |

Each output has the following specifications:
$V_{DSMAX}$ = 60 V $V_{GSMAX}$ = ±20 V

**More reasons to use Power+ Arrays for fractional-hp motor drive:**

- Monolithic integration of 3, 4 or 6 power transistors for reduced board space
- SOIC packaging
- Matched transistors for simplified predrive circuitry and feedback loops
- High avalanche energy rating for inductive load switching
- Cost-effective pricing (unit price in 1,000s):

| | | | |
|---|---|---|---|
| TPIC2302 | $1.20 | TPIC5404 | $1.60 |
| TPIC3302 | $1.20 | TPIC5601 | $2.40 |
| TPIC5302 | $1.20 | (Suggested resale unit price) | |

**PRISM: The power behind Power+ Arrays.** TI's PRISM process, which is optimised for low on-state resistance, has made it possible to integrate up to six power DMOS transistors on a single chip and minimise total power dissipation, achieving higher performance than possible in a less efficient process. Only TI has this PRISM process, and, as a result, only TI offers single-chip DMOS motor drivers like Power+ Arrays.

**There's more to Power+ Arrays.** For more information, simply circle the reader response number below.

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TEXAS INSTRUMENTS



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CIRCLE NO. 163

Feels like a scope.

Sets up like a scope.

Displays like a scope.

# Could this really be a logic analyzer?




Sixteen channels of 500 MSa/s logic analysis in a box that drives like a scope may seem impossible. Until you see the HP 54620A logic analyzer.

**Will this setup procedure convince you?**

Connect the inputs, hit autoscale, look at the display. You'll get the benefits of logic analysis — including advanced triggering — without the learning curve.

**The HP 54620A will change your attitude about troubleshooting.**

Its range of triggering allows you to match the complexity of your problem. The high-speed display system shows you unstable signals. And because of its remarkably rapid display update rate and instantaneous feedback, you can operate this with a simple twist of a knob.

The HP 54620A — a logic analyzer that really is as easy to use as your scope. A pretty convincing case.

Call your local HP sales office or one of the numbers listed below and find out how to get the power of logic analysis without the learning curve.

There is a better way.

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CIRCLE NO. 85

# The Top 100 products from the *EDN* reader's perspective

Welcome to *EDN*'s second annual Top 100 Products Issue. We designers depend on the latest, most competitive tools and components to keep our designs competitive. Throughout the year, *EDN* feeds you a constant stream of the latest and most interesting products available from vendors. Using our reader-service cards, you respond with a constant stream of requests for more information on these products. We carefully track those inquiries and total the scores at the end of the year.

In this issue, you'll find the top-scoring products from the previous year's worth of *EDN*, stretching back to October 1993. These are the products that *EDN* readers have singled out for unprecedented levels of performance or for their ability to drastically cut the cost of the function they perform. Some products are just plain neat.

For whatever reason, the products featured in this *EDN*'s Top 100 are the products that the design community found most interesting during the year. I suggest you take a look at the winners. You never know what you might have missed.

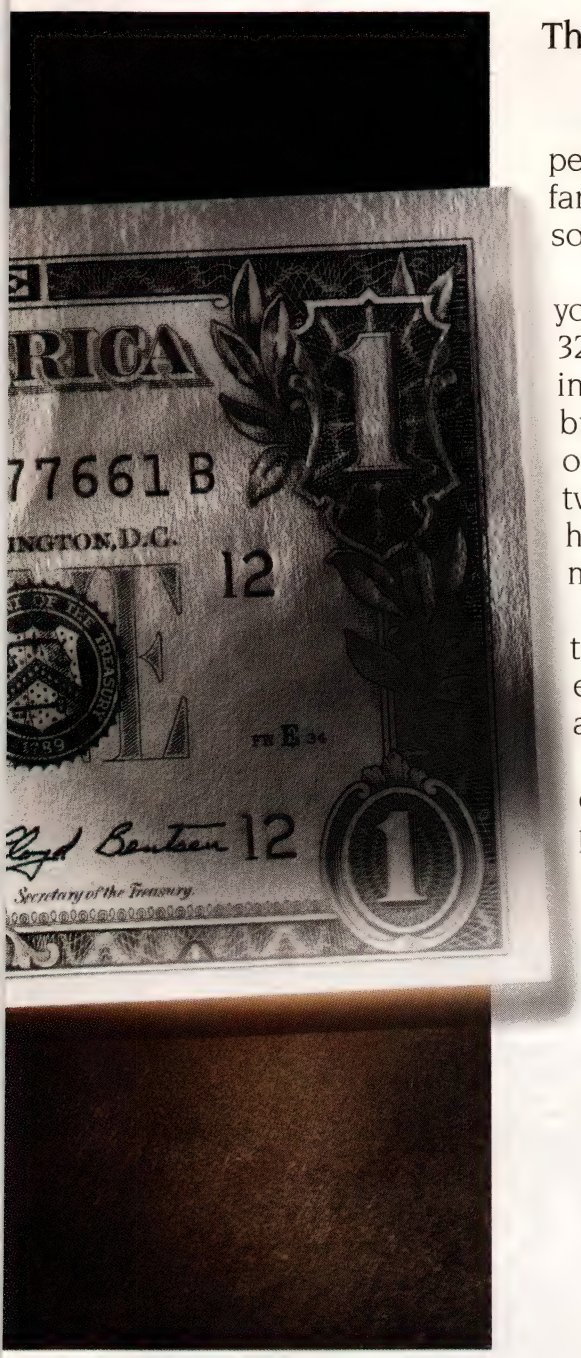
Steven H. Leibson

**EDITOR IN CHIEF**

*Send me your comments via fax at (617) 558-4470, or on the EDN Bulletin Board System at (617) 558-4241, 300/1200/2400 8,N,1. From the Main System Menu, enter ss/soapbox and select W to write us a letter.*

# You Don't Buy An Processor Based

# Embedded RISC On Price Alone.



## The 29K Family From AMD®—The High Performance Embedded RISC Controllers.

We know what's at the top of your priority list: performance. So fasten your seat belt and experience the 29K™ family, the high performance embedded RISC microprocessors and microcontrollers that help reduce system costs.

Built for speed from the ground up, the 29K family gives you all the advantages of RISC technology and a 32-bit core. Plus Scalable Clocking™ enables the internal processor to run at twice the external bus speed. That means speeds up to 50MHz on our new Am29040™ microprocessor — twice as fast as the i960CF. Performance so high you don't have to use more expensive memory chips, which saves a bundle in system costs.


*Our new Am29040 reaches speeds of 50MHz and 65 Dhrystone MIPS, and still reduces your overall system costs.*

No matter which 29K device you choose, you'll maintain the highest performance as you upgrade, since the entire family is binary compatible. So as the family advances, so can your designs.

Thanks to the Fusion29K® partners, implementation couldn't be easier. You'll choose from hundreds of third-party design and development tools to bring your design to market in record time.

To keep your performance running at an all-time high, and keep your costs down, look to the 29K embedded RISC family from AMD. Contact your local AMD sales office, listed below, for details. And see how incredibly fast you can drive your system costs down.

*Ask for Literature Pack 16G.*

**Advanced Micro Devices**

NOT THE SA

# The World's First 17MHz Rail-to-Rail I/O Op Amp (@ $I_S$ = 650µA)

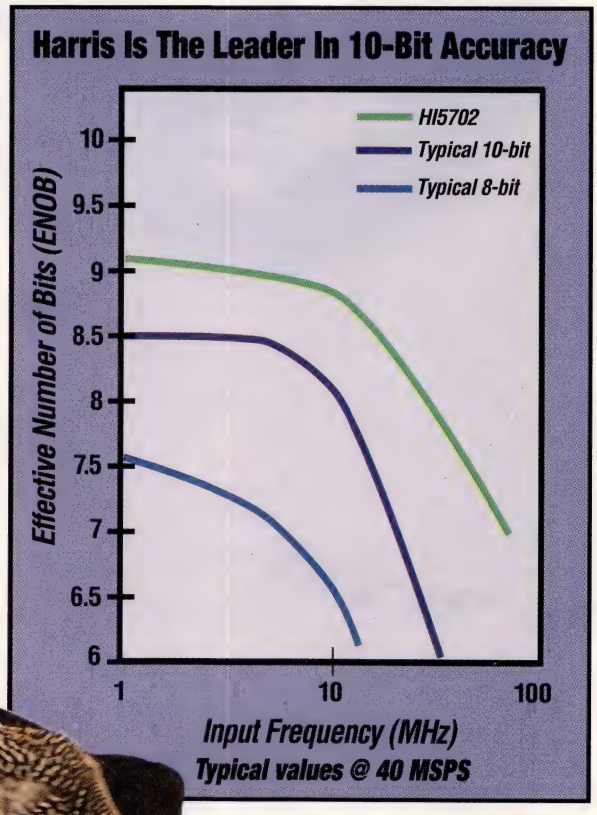
# ME OLD WAVE

**The LM6142 / 4** ~ Ultra-high gain-bandwidth of 17MHz @ 50KHz while drawing just 650µA of supply current @ +5V ~ Rail-to-rail input and output ~ Guaranteed single-supply performance ~ Excellent DC precision (Vos of 1mV; CMRR of 107dB) ~ Operates from +1.8V to +24V supplies ~ Low voltage noise ($e_n$=13nV/$\sqrt{Hz}$ @ 1KHz) ~ For a free product sample kit and ordering information, call **1-800-NAT-SEMI, Extension 305.**

National Semiconductor

# THE WORLD'S MOST ACCURATE HIGH SPEED 10-BIT A/D.

Next time you need a 10-bit A/D, don't settle for second best. The new HI5702 high-accuracy, high-speed 10-bit A/D converter from Harris is the most accurate A/D of its kind, with 8.3 Effective Number of Bits (ENOB @ $f_{in}$=10MHz) precision — guaranteed. Use it to improve the performance of an 8-bit design. Drop it into an existing 10-bit design for more dynamic range. Or use it to consolidate IF stages in a wireless design. Wherever you use it, the HI5702 gives you a sharper edge in signal quality and performance. Call us to find out more. Then get ready to raise your design to new heights.




## HI5702 Features

- GUARANTEED 8.3 Effective Number of Bits (ENOB) @ $f_{in}$=10 MHz
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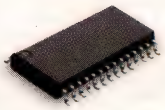
- Widest Analog Full Power Bandwidth (FPBW): 250 MHz
- Spurious Free Dynamic Range (SFDR) @ $f_{in}$=10 MHz: -63dBc
- Intermodulation Distortion (IMD) @ $f_1$=1 MHz, $f_2$=1.02 MHz: -59dBc
- DNL +/– 0.5 LSB
- Differential Gain/Phase: 0.5%/0.25°
- Priced from $38.63 (1k)



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CIRCLE NO. 84

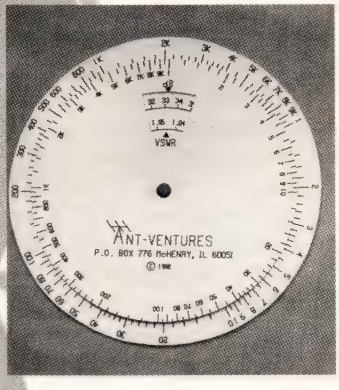
# 'Tis the season for tech toys

After spending all year working on designs, the holiday season is the perfect time to take a break and kick back with our tech toys. This year we chose products that will brighten up your work or play. The items range from inherently practical to merely fun, plus we've included a book section for those long winter nights.

Check out the credit-card-sized computer, watch the sunrise on Venus via a CD-ROM, or road trip through the Internet. You can play with neural-network software, turn your printer into a fax, or increase your night vision. You can design at high speed using a shared-port RAM, or liven up any data by using data-analysis software with 3-D capabilities. Check out a tiny video camera or let a software package show you how to make a better paper airplane.

Some of these toys are inexpensive, so treat yourself to more than one. Take a break, have a happy holiday season, and enjoy the toys.

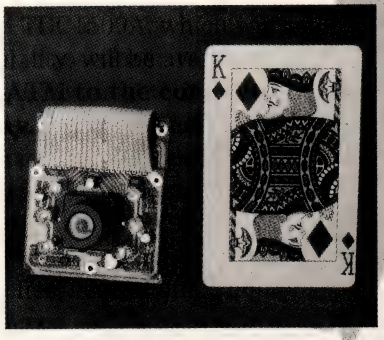
*—by Anne Coyle, Associate Editor*




## HANDY CALCULATOR QUICKLY COMPUTES VSWR

This inexpensive, pocket-sized calculator eliminates the need for complex charts or complicated formulas for calculating VSWR, return loss, feed-line loss, or amplifier gain. You make calculations by lining up the appropriate marks on the two outer scales and reading the result. The device's diameter is 4 in. $5.95. **Ant-Ventures**, McHenry, IL. (815) 344-1702. **Circle No. 361**

## TINY CCD VIDEO CAMERAS



These micro-sized video cameras come in color and black-and-white models and facilitate design into most enclosures. The unit's low price ($149 for the black-and-white model) provides you with a range of design options, including surveillance and security devices, industrial equipment, and PC multimedia applications. The cameras operate on low power (80 mA) and contain an IR-LED array that allows for monitoring in dark areas. **Polaris Industries**, Atlanta, GA. (404) 252-3340. **Circle No. 363**

## CREDIT-CARD-SIZED COMPUTER

The Cardio-486 is a fully functional IBM PC/AT computer that measures 3.4×2.2 in. You need to add just an interface and an input device, depending on the application. The card consists of an Intel 486SL super chip set including 8 kbytes of cache and an FPU. The card also contains 4 or 8 Mbytes of memory, PC/AT BIOS ROM, and an I/O controller with two serial, one parallel, and one speaker port. Products using the board include point-of-sale systems, test and measurement equipment, set-top boxes, and global-positioning systems. The 8-Mbyte version costs $1800. In quantities of 1000 or more, the card costs approximately $1000. **S-MOS Systems Inc**, San Jose, CA. (408) 922-0200. **Circle No. 362**

## HOW TO GET A WELL-TRAINED NETWORK

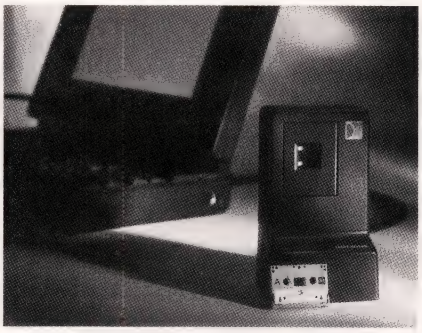
BrainMaker Professional v4.0, the upgrade for BrainMaker Professional neural-network software, provides versatile data handling and features more spreadsheet functions and formulas than its predecessor. The software lets you create networks that learn from experience, not by programming. The added features include cell and column formulas and functions, easier data exchanges with other programs, and full Windows functionality, including user-definable windows. The software costs $795. Upgrades are $250 for BrainMaker Professional users and $595 for Standard BrainMaker users. **California Scientific Software**, Nevada City, CA. (916) 478-9040. **Circle No. 365**

## EXPLORE THE WORLD OF VIRTUAL REALITY

The VREAM virtual-reality development systems allows users to develop and execute interactive, textured worlds on a PC. The system's 3-D word editor lets the you draw objects that comprise the virtual reality, and the runtime system allows you to enter the world and interact in real time. Because the system doesn't require user programming or additional interface hardware, it suits beginners. $795. **VREAM Inc**, Chicago, IL. (312) 477-0425.
**Circle No. 367**

## CARRY DATA AND SOFTWARE WITH YOUR PORTABLE COMPUTER

If you are tired of waiting for your modem to transfer data to your computer, the Pereos may be for you. The device, a mobile-companion storage product for notebooks and subnotebooks, allows you to carry all of your information and software in a package that weighs less than 10 oz. The Pereos runs on two AA batteries and can store from 1 to 100 Gbytes of information. It plugs into your computer's parallel port and uses a standard Windows interface. $595, including software. **Datasonix Corp**, Boulder, CO. (303) 545-9500.
**Circle No. 366**



## USE YOUR WORDS INSTEAD OF A MOUSE

If you are tired of battling with a mouse to navigate through Windows, check out the JustVoice speech-recognition system. The software responds to commands such as "Open a file" and "E-mail the document" without requiring additional keyboard input. The software operates with an 8-, 12-, or 16-bit card. The system has an unlimited vocabulary size and allows you to input commands as needed. The software costs $79.95 and includes a manual. **Interactive Products Inc**, Eugene, OR. (503) 341-4964.
**Circle No. 368**

## CHECK YOUR STARS

Imagine watching a sunrise on Venus or viewing a total eclipse of the moon. Now you can, and without a high-power telescope or having to visit a planetarium. The Redshift CD-ROM allows you to place yourself anywhere in space and time, from your own backyard to the most remote corner of the solar system. Redshift displays over 300,000 stars and more than 40,000 comets, asteroids, and deep-space objects. You can purchase the CD-ROM for either the Mac or PC. $99. **Maris Multimedia**, San Rafael, CA. (800) 336-0185. **Circle No. 369**

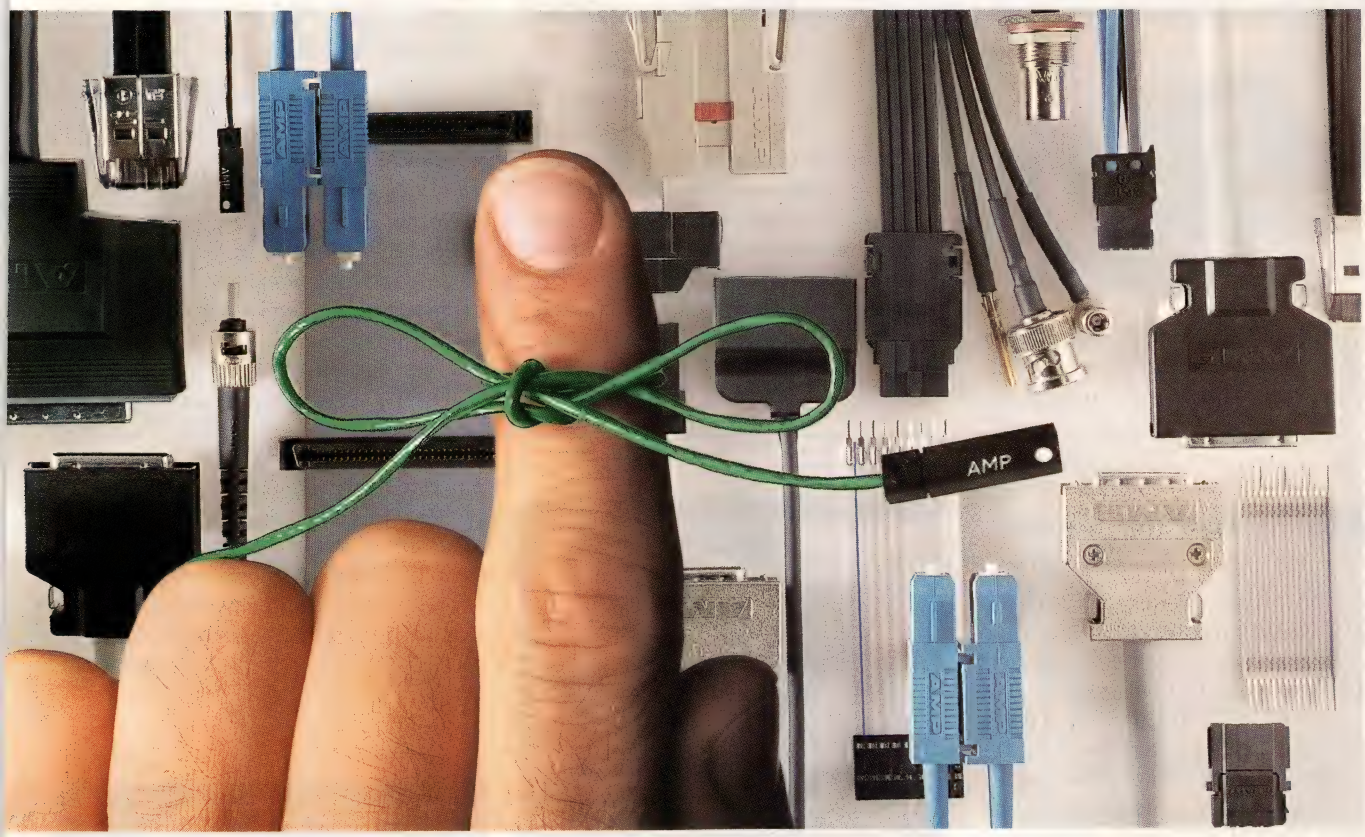
## LIGHT UP YOUR CHRISTMAS

The LED-Tric Christmas tree's 18 multicolored, ultrabright LEDs form a fun centerpiece. The 7-in.-high tree consists of three branches that display the red, orange, yellow, and green lights through open circuitry. The tree operates for one month on two alkaline C batteries (included). A preassembled tree costs $45.50, or you can buy the materials to assemble it for $35.50. **Vista**, Bolingbrook, IL. (708) 378-5534.
**Circle No. 370**

## DATA ANALYSIS GETS EASIER

KwitStat 4 allows you to quickly summarize data into understandable charts and tables. The software's 3D SmartPoint feature displays the data "behind" the graph. You can use the software for forecasting, quality control, analysis graphics, and comparative statistics. $229. **TexaSoft**, Cedar Hill, TX. (214) 291-2115. **Circle No. 371**

# *Lots of cable assemblies. Only one name to remember. AMP.*




Cutting edge digital. Garden-variety ribbon. High-performance fiber. Whatever your cable assembly needs – from the standard to the technologically advanced – there's only one company to call. AMP.

Our cable assemblies for high-speed data applications provide effective signal management for your advanced designs. We control all the details, custom-fitting our own cables, connectors, and termination techniques to meet your critical impedance and risetime parameters. Control lets us keep a lid on costs, too. Categories: transmission line, microstrip, coax ribbon, and extremely fine-gauge coax are available for all demanding applications.

For commodity needs, our global manufacturing and distribution strength is your key to reliable, affordable assemblies – and reliable delivery anywhere in the world. And if fiber is your medium of choice, our leadership in fiber optics is your ticket to higher performance, value, design ease and simpler manufacturing.

So remember, when the occasion calls for cable assemblies, you can count on our capabilities – from design assistance to volume production. And all the details are just one phone call away.

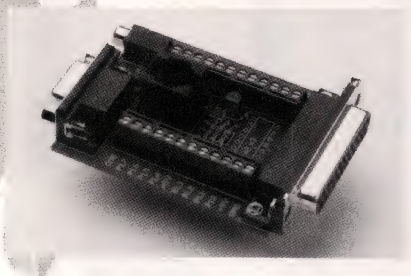
AMP is a trademark.

**Scandinavia:** Sweden 46-8-580-833-00 (fax 46-8-580-194-70)
**Central Europe:** Holland 31-73-20-0911 (fax 31-73-21-2365); Germany 49-6103-7090 (fax 49-6103-709223); Great Britain 44-81-954-2356 (fax 44-81-954-6234)
**Southern Europe:** France 33-1-34-20-8888 (fax 33-1-34-20-8600); Italy 39-11-401-21111 (fax 39-11-403-1116); Spain 34-3-200-8466 (fax 34-3-201-7879)

AMP

CIRCLE NO. 9

## TAILOR BASIC PROGRAMS WITH TINY CONTROLLER BOARD



The Xplor-32 personal digital controller (PDC) combines read/write technology with a Basic interpreter.

The board, which measures 2.15×2.2 in., includes an Intel 80C32 CPU, an 8-kbyte EEPROM, a serial port, and a 5V regulator. You can use the board for embedded control, to limit monitoring, and for data-logging applications. You can interactively edit Basic programs, and any stored Basic program automatically executes on power-up. $59.95. **Blue Earth Research**, Mankato, MN. (507) 387-4001. **Circle No. 372**

## TURN YOUR FAX MACHINE INTO A PRINTER

Datafax+ Windows fax software comes bundled with Trio FaxConverter, a pocket-sized device that converts any fax machine into a scanner or a local printer. The converter lets you scan a document into a PC and process it by using OCR (optical character recognition). The software includes a DOS client so the device can run under Windows or DOS workstations. Features include a quick-fax icon that lets you take information from any Windows application and instantly fax it, without needing to leave the application. Best of all, the software lets you block incoming numbers to prevent junk faxes. $129. **Trio Information Systems**, Raleigh, NC. (919) 846-4990. **Circle No. 373**

## MAKE THE PLAY THIS SEASON

Attention all you arm-chair quarterbacks: "NFL's Greatest Plays," an interactive CD-ROM, could be the perfect addition to your football season. The CD contains 75 of the greatest plays in football history, as determined by the NFL. The program allows you to study each play from three camera angles and run the plays at any speed, forward or reverse. You can also call up the statistics of each play, including the players, score, field conditions, and game outcome. The CD requires a Windows PC with 2 Mbytes of hard-disk space, 4 Mbytes of memory, and a 386 processor (486 recommended), or a Macintosh with 2 Mbytes of hard-disk space, 3 Mbytes of RAM, a 68030 processor or better, and System 7.0 or higher. The CD costs less than $30. **Turner Interactive**, Atlanta, GA. (800) 294-0022. **Circle No. 374**

## INCREASE YOUR NIGHT VISION

The Night Vision B-19 is a high-performance night-vision device ideal for amateur astronomers, scientists, or nature lovers who want to explore their surroundings at night. The device contains an electrostatic image intensifier tube with low power consumption and has a built-in illuminator. $695. Pressebo Electronics, Ventura, CA. (805) 659-4055. **Circle No. 375**

## TEXT TALK

This text-to-speech software converts ASCII text into natural-sounding artificial speech under Windows 3.1. To generate text to speech, the software's linguistic module first analyzes the ASCII text input. The phonetic module then takes the linguistic module's output and calculates speech parameters, and the acoustic module generates the speech. The software package includes sample programs, a reference guide, and an evaluation package. $1999. **Lernout & Hauspie**, Woburn, MA. (617) 932-4118. **Circle No. 376**

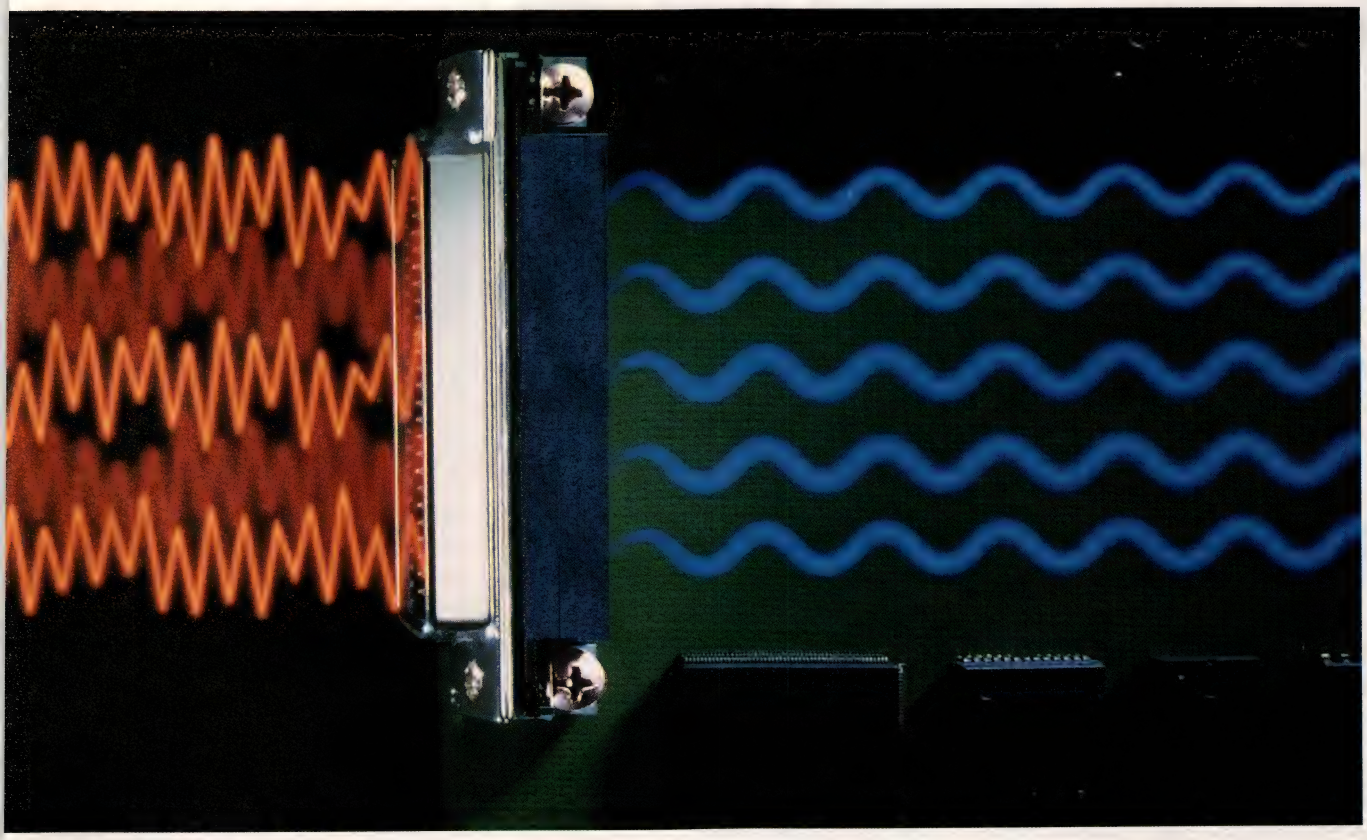
## GIVE YOUR PRODUCT A VOICE

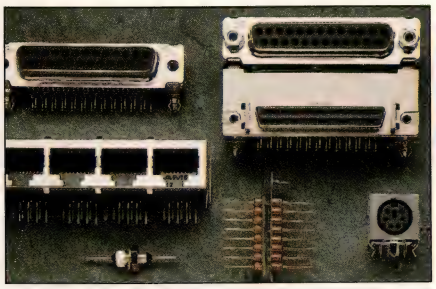
The ET-VM2000 module allows you to design natural voice recordings on a 1×2.4-in. board. The module has 20 sec of recording time, an onboard microphone, a record button, and an LED record indicator. The device has a 100-year message retention and does not require a programmer. $50 for two. **Electronic Design to Market Inc**, Toledo, OH. (419) 389-0354. **Circle No. 377**

## SUBNOTEBOOK EXPANDED TO INCLUDE DISK-BASED APPLICATIONS

The OmniBook 430 PC allows users to access and run their choice of applications. The PC contains a 105-Mbyte hard drive with 6 Mbytes of RAM. It's easy to carry, measuring only 11.1×6.4×1.4 in. and weighing just 2.9 lbs. Special features include instant on, which allows you to resume working in the same program when turning on the machine, even if you didn't save the file. $1599. **Hewlett-Packard**, Palo Alto, CA. (800) 443-1254. **Circle No. 378**

# AMP filtered connectors drop in. EMI problems drop out.





| FILTER TYPE | INSERTION LOSS* |
|---|---|
| Ferrite | 3-8 dB |
| Capacitive Film | 10-30 dB |
| Chip Capacitor | 10-40 dB |
| Capacitive Array on Ferrite | 15-40 dB |
| Tubular Capacitor | 20-40 dB |
| Distributed Element | 20-90 dB |

*typical performance @ 100MHz, 50 Ω system

If you're tackling EMI noise problems with discrete components on the pcb, we've got a much better idea for you. AMP filtered connectors provide the EMI answer you're looking for – and they do it quicker, and easier, at a lower cost.

These one-piece, fully integrated problem-solvers drop right in to standard footprints – eliminating the hassle and time loss of board redesign when you find yourself facing EMI problems in a finished design, or in an existing product.

And if you need to control costs, just add up the expense of on-board filtering – loose components, inventory cost, extra assembly steps, and lost board real estate – and compare for yourself. Filtered versions of our most popular connector types do a better job, with solid, characterized performance. And they can often do it at a lower final cost.

We offer the broadest range of filtering technologies available, in the world's best connectors (ours) – from sub-Ds to mini-ribbon cable, mini-DINs to mod jacks. We also have loose-piece and cable styles, and provide custom services as well.

When you're up against EMI problems – or better yet, before you come up against them – we can provide the fast, simple solution, and save you money at the same time! Talk with your AMP distributor for details, or give us a call today.

AMP is a trademark.

**Scandinavia:** Sweden 46-8-580-833-00 (fax 46-8-580-194-70)
**Central Europe:** Holland 31-73-20-0911 (fax 31-73-21-2365); Germany 49-6103-7090 (fax 49-6103-709223); Great Britain 44-81-954-2356 (fax 44-81-954-6234)
**Southern Europe:** France 33-1-34-20-8888 (fax 33-1-34-20-8600); Italy 39-11-401-21111 (fax 39-11-403-1116); Spain 34-3-200-8466 (fax 34-3-201-7879)

AMP

CIRCLE NO. 17

## THUMBING ON THE INTERNET

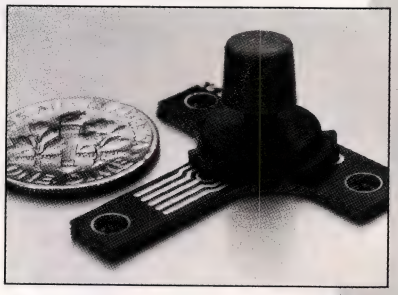
If you haven't cruised the Internet yet, try picking up the CD-ROM, "Hitchhiking on the Information Highway." This Windows software package is fun for first-time and experienced user alike. The CD includes Softerm communications software and terminal emulators, instructional video clips in AVI format, trial subscriptions to several on-line services, and reference documentation. The on-disk document library has text to books, such as *Internet Basics* and *Hitchhiker's Guide to the Internet*, along with a SLIP (Serial-Line Internet Protocol) TCP/IP (Transmission Internet Protocol, Internet Protocol) kernel for serious Internet users. You can also look through a database of more than 15,000 BBS descriptions. And, just for fun, you get Icon Hear-it, a software package that adds sound to your Windows icons—and even lets you cheat at Solitaire. $99.99. **Moon Valley Software**, San Luis Obispo, CA. (805) 781-3890.

**Circle No. 379**

## HIGH-FLYING SOFTWARE

**"The Greatest Paper Airplanes" provides a high-tech twist on making paper airplanes. The software requires Windows 3.1 or higher and contains 3-D tutorials and text explanations to give you a step-by-step guide on how to fold each of the 25 airplanes. The software supports color printing to give your airplanes an artistic or military design. The software regularly costs $39.95, but the price is taking a nose dive to $29.95 through December. Kitty-Hawk Software, Tucson, AZ. (602) 797-4583.** **Circle No. 380**

## ONE-TOUCH CURSOR-CONTROL AND CLICK FUNCTIONS



The ClickStick computer pointer combines cursor-control and primary-click-button functions in one joystick for PCs. One tap of the joystick acts as a mouse click; two taps initiate a double click. The $150 price includes software and design instructions. **Interlink Electronics**, Camarillo, CA. (805) 484-8855.

**Circle No. 381**

# WINTER READING

***Document Image Analysis***, edited by Lawrence O'Gorman and Rangachar Kasturi. IEEE Computer Society Press, 1994, Los Alamitos, CA. $44.

This book provides an easy-to-use guide for the techniques, systems, and methods used in document image analysis. Each chapter allows you to identify and address the difficulties and options associated with the automatic interpretation of printed and handwritten documents.

**Circle No. 382**

***Vision Chips: Implementing Vision Algorithms with Analog VLSI Circuit***, edited by Christof Koch and Hua Li. IEEE Computer Society Press, 1994, Los Almitos, CA. $55.

You can explore the recent advances in the implementation of vision algorithms onto analog vision chips. The book reviews the problems of early vision and examines the acquisition of early images and the use of spatiotemporal filtering to remove noise and emphasize image features.

**Circle No. 383**

***Electronic Logic Systems***, 3rd ed, by A.E.A. Almaini. Prentice Hall International, 1994, Hertfordshire, UK. $64.

This reference guide to electronic logic systems describes essential theory, components, and practical design techniques for combinational and sequential logic circuits.

**Circle No. 384**

***LabView Graphical Programming—Practical Applications in Instrumentation and Control***, by Gary W Johnson. McGraw-Hill, 1994, New York, NY. $45.

This book gives you an in-depth tutorial on how to use LabView and desktop computers to develop automated instrumentation systems for engineering and scientific applications. You can use the book and included disk as a system-development guide and for data acquisition, instrument control, and analysis.

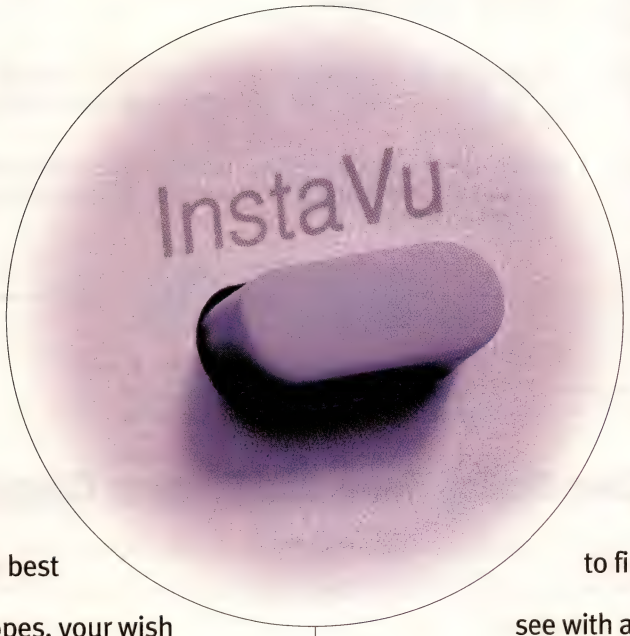
**Circle No. 385**

***IEEE Brainbuster Gamebook***, by Donald R Mack. IEEE Press, 1992, New York, NY. $9.95

Give yourself a mental workout with this book of over 180 brain teasers. You can choose among logic, mathematical, and engineering problems beginning with easier problems and working your way up to the more difficult. And, best of all, the book provides in-depth solutions.

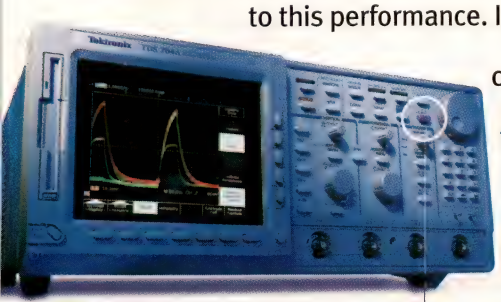
**Circle No. 386**

# Faster than an analog scope. And with instant replay.




If you've ever dreamed of an instrument that combines the best of both analog and digital scopes, your wish has been granted. Tektronix TDS 700A TruCapture™ oscilloscopes are actually faster than the fastest analog scopes. Yet they give you the playback power of digital technology. All at the touch of a button.

Our new InstaVu™ acquisition system is the key to this performance. In a second, it captures glitches that might take other digitizing scopes hours to find. Such as events you could see with an analog scope but were unable to store and review later.



The TDS 700A series gives you true representation of signals, with up to 1 GHz bandwidth and a 4 GS/s sample rate. Plus, it's got the same familiar interface as the entire TDS line so you won't have to learn anything new.

To discover how the world's fastest oscilloscope can help you work more efficiently, call your local Tektronix Representative today.

Tektronix

55A-500053

ISO 9001

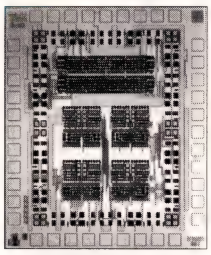


CIRCLE NO. 154

# COMPLETE HIGH-FREQUENCY

**MIXED SIGNAL WITH 60K DIGITAL GATES • CUSTOM • HYBRIDS**

## Get High-Frequency Designs Quick with QuickChip Design Automation



Maxim's QuickChip design automation approach consists of several "core" array families of high-speed bipolar transistors, capacitors, and resistors, optimally configured for interconnection. QuickChip arrays are easy to use, and since there are only a few masks to design, QuickChip is less expensive and less time consuming than the full custom approach. Once final designs are completed and approved, finished wafers can typically be delivered within 4 weeks.

**This QuickChip 7 array on the GST-1 process has one digital (ECL) macro-tile and four analog macro-tiles for a total of: 592 NPNs, 56 PNPs, 64 Schottky diodes, 64 ESD diodes, 1,408 resistors, 48 MOS capacitors, and 40 pads.**

### QuickChip Project Flow

*Definition (4 weeks)*
**Determine feasibility, establish objective specifications, choose process, order software.**

*Software Training (2 days)*
**Maxim engineers will train you to use QuickChip Design Tools included in the QuickTools package: ADS (Analog Design System), QuERC, and QuicKic.**

*Design & Layout (project dependent)*
**Using ADS, you design and simulate the circuit, check electrical rules with QuERC, and layout IC with QuicKic. Maxim will review both design and layout.**

*Tapeout & Wafer Fabrication (4 weeks)*
**Using your QuickChip design, Maxim will manufacture die. Up to four custom masks required.**

*Packaging (3 weeks)*
**Maxim packages ICs. Over 95% of 1st pass ICs meet the original objective spec. Production testing available.**

*Delivery of Prototypes*
**Final prototypes can be evaluated in your system.**

## World-Class Design Tools and Process Capabilities

Maxim's design tools shorten design time and help meet target specifications on the first pass.

**QuickTools** is a powerful software package that provides design engineers with complete IC, schematic, simulation, and layout capabilities. It includes:

- **ADS,** an integrated schematic capture, circuit simulation, results processing, and display environment.
- **QuERC,** a bias analysis electrical rules checker.
- **QuicKic,** a fast, error-free netlist-driven layout editor that checks process design rules, connectivity,and interconnect parasitics as the layout is being accomplished.

All processes are available for full custom work. C-Pi/SHPi and GST-1 have QuickChip arrays in various configurations to meet your requirements.

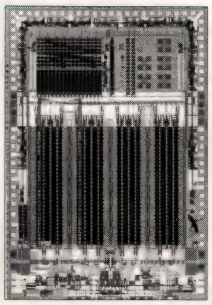
| NAME | NPN $BV_{CEO}$ (V) | NPN $f_T$ (GHz) | PNP $BV_{CEO}$ (V) | PNP $f_T$ (GHz) | JFET | DIGITAL DENSITY (GATES) | ISOLATION | METAL LAYERS | THIN FILM RESISTORS | SCHOTTKY DIODE |
|---|---|---|---|---|---|---|---|---|---|---|
| SHPi | 8 | 9 | 9 | 0.1 | YES | 3K | OXIDE | 2 | YES | YES |
| C-Pi | 9.5 | 9 | 10.5 | 5.5 | YES | 3K | OXIDE | 2 | YES | YES |
| GST-1 | 5.5 | 13 | — | 0.1 | NO | 20K | TRENCH | 3 | YES | YES |
| GST-2 | 4.5 | 27 | — | 0.1 | NO | 60K | TRENCH | 3 | YES | YES |

- **C-Pi** is a recessed-oxide-isolated high-speed complementary bipolar process optimized for analog signal acquisition, amplification, and sourcing. Without the vertical PNP option, C-Pi is designated as **SHPi**.
- **GST-1** is a high-speed self-aligned double-polysilicon bipolar process ideally suited for highly integrated, mixed analog, and digital ICs. **GST-2** offers the highest speed and device density, with 27GHz $f_{TS}$ and up to 60K gates/IC.

# DESIGN SOLUTIONS UP TO 27GHz

## STATE-OF-THE-ART DESIGN TOOLS AND PROCESS TECHNOLOGIES

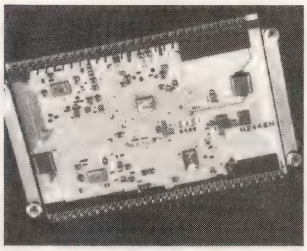
### Maxim's Full Custom Approach



In addition to the QuickChip approach, Maxim also offers a high-frequency full custom capability. This method is ideal for high-volume products where optimized unit cost reduction and ultimate high frequency performance are key factors. Full custom offers complete flexibility in choosing individual devices and location. Your custom IC can be fully designed by either Maxim's experienced design staff or by your own skilled analog designers using Maxim's design tools.

**This 8-bit 500 Msamples/sec A/D converter is a full custom design. It has full flash topology and greater than 500MHz small signal bandwidth.**

### Hybrid and Module Development



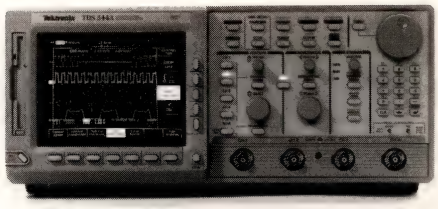
Our high-frequency hybrid design and manufacturing group can develop your complete system. Using HCAD-III, an internally developed hybrid software design and layout system, multi-chip modules (MCMs) can be developed that will work right the first time. Process capabilities include: thick film, thin film, multilayer ceramic, MCM, chip and wire, mixed technologies, electro-optic, and electrical test and trim up to 60GHz. Examples of previously designed hybrids include 350MHz video display drivers and ATE pin drivers for 100MHz test systems. Our high-frequency packaging and assembly expertise is second to none! Let Maxim help you with high-frequency problems.

**This multichip module uses two full custom Maxim ICs and two custom CMOS ICs. It represents a complete 200MHz analog oscilloscope on a board.**


**Our Free High-Frequency ASIC Development Handbook takes you through all the steps to integrate your circuitry on high-performance ASICs and Modules.**

**To get started, call Maxim Toll Free at 1-800-809-0840 to discuss your specific application.**

### Another of Our Many Success Stories: Tektronix Uses Maxim's Custom ASIC Processes for its TDS Series Oscilloscopes

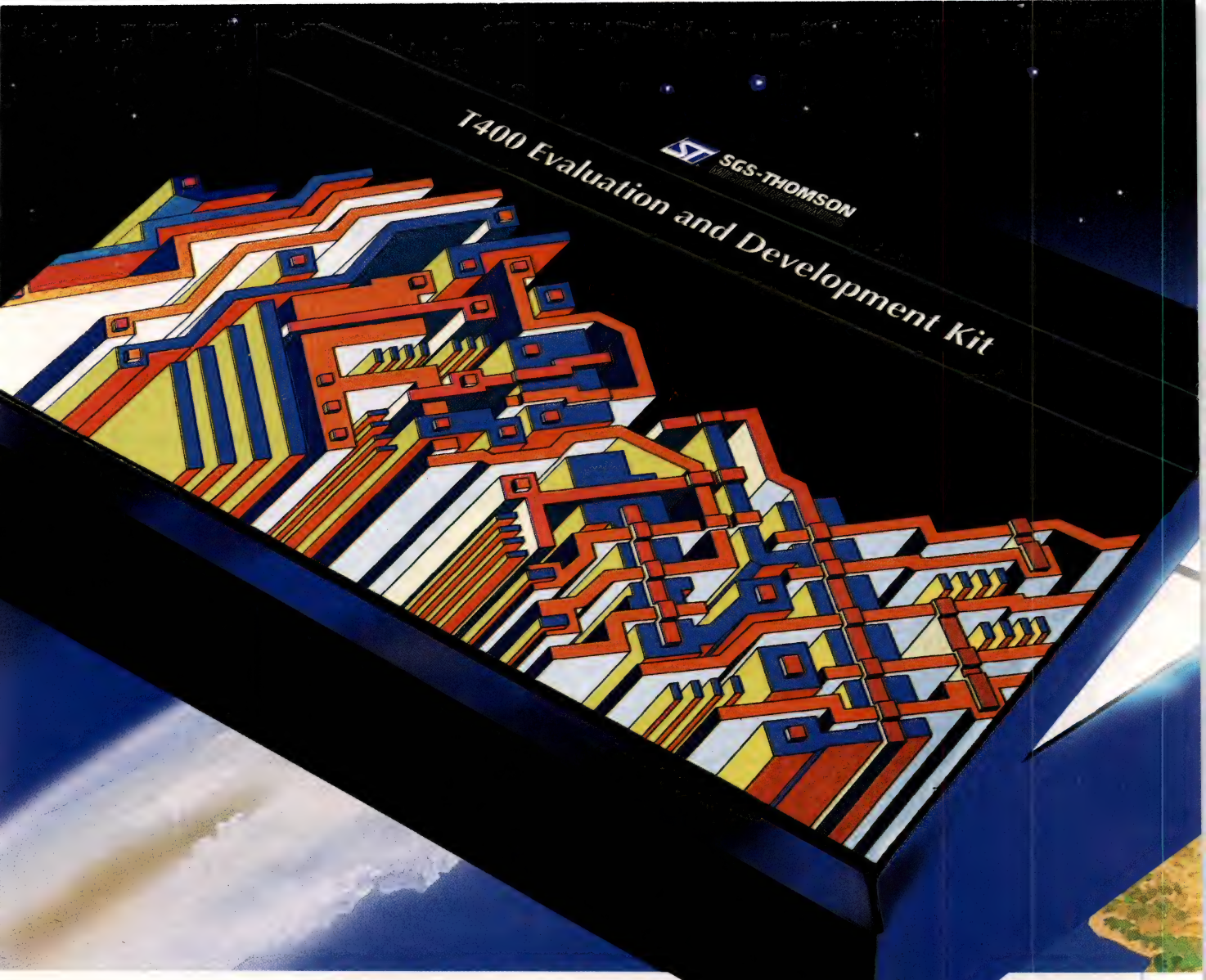


***Case History #5:*** *The Tektronix TDS 544A Four-Channel 500MHz Color Digitizing Oscilloscope received EDN's Test and Measurement Product of the Year Award. This product contains 13 custom ICs and four custom hybrids manufactured using Maxim's SHPi and GST-1 processes. Maxim-fabricated circuits include four 250 MS/sec A/D converters for signal acquisition, circuits that provide normal and specialized trigger functions, a 500MHz buffer with precision delay adjustment, wide band input amplifiers with variable gain and position control, and hybrid precision attenuators with Maxim die. Maxim-fabricated circuits make possible this instrument and many others in the Tektronix Test and Measurement family of products.*

MAXIM

ISO 9001
Certificate Number: 30337

CIRCLE NO. 104




# Discover the Worl Without Payi

**You want to get into the world of real 32-bit embedded processing but you don't want to pay the earth?**

Now you can with SGS-THOMSON's STEK400. Following the successful starter kit format used for the ST6 and ST9 microcontrollers, the kit contains everything you need to evaluate and start development of your own 32-bit embedded system, including an ANSI C compiler with full documentation and target board. In addition the STEK400 includes a quick start manual to get you working straight away, plus the T400 family databook.

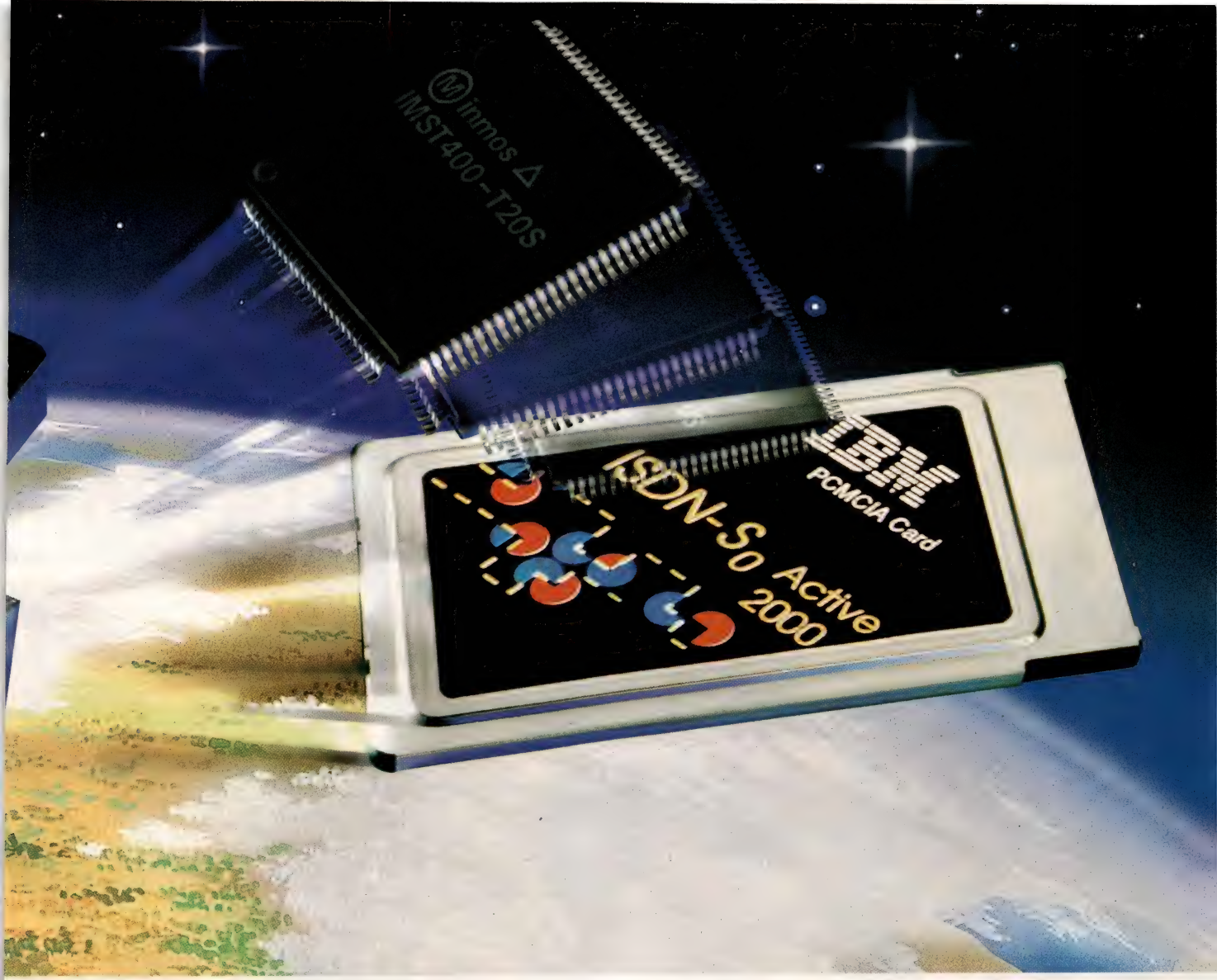
## T400 Power Performance Price

The T400 offers the optimum mix of power, performance and price for all high-end embedded processor applications. **Power** from a RISC-based 32-bit architecture with 4Gbyte memory address space. **Performance** with a 20MHz CPU giving up to 20MIPS, and benchmarks of 704k Whetstones and 8193 Dhrystones per second. **Price** that puts the T400 well within the reach of your applications budget - under $20 in volume, or, in other words, less than $1/MIPS.

## Simply Better for High-End Applications

The T400 makes it easy to develop systems and applications software even for demanding applications like fax machines, laser printers, GPS handsets and wherever else price and performance are the major parameters for success.

The T400 microprocessor contains many facilities for simplifying both hardware and software design.

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- In-built programmable interface
- Data transfer port for in-line programming, diagnostics and I/O
- Programmable memory interface
- Single external 5MHz clock
- High code density so your application code occupies less memory
- Comprehensive library and hardware support for multitasking, intertask communication and the use of timers and interrupts

If you want to know more on better microprocessing for demanding applications, fill in the coupon - you'll find the world of 32-bit embedded processing won't cost you the earth.

I want to open up the world of 32-bit embedded processing, please rush me:

❒ The STEK400 Evaluation and Development Kit for under $600

❒ Information on the T400 32-bit microprocessor

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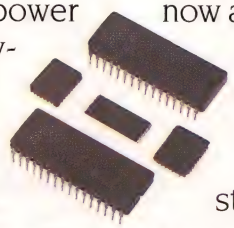
SGS-THOMSON MICROELECTRONICS
*Service and Technology*

CIRCLE NO. 144


# Why Is The Industry Rallying

The people have spoken. AMD® has heard your demands for Flash technology that reduces system costs through single power supply operation. And AMD has delivered — with the Am29Fxxx family of 5.0 Volt-only Flash devices.

The response was overwhelming. The industry is lining up behind the Am29Fxxx Flash standard. Fujitsu, Motorola, and SGS-Thomson are committed to supplying compatible Flash devices. And AMD is committed to volume, now and in the future, with the world's largest, 0.5 micron Flash manufacturing facility. Which means more sources, and more Flash memories for you.



*The Am29Fxxx Flash family ranges in density from 1 to 16 Mbits and includes x8/x16 user-configurable design.*

Why has AMD Flash garnered such strong support? Because the Am29Fxxx family offers what engineers need. Including our patented Negative Gate


# Behind AMD's Flash Family?

Erase technology for cost effective 5.0 Volt-only operation. Embedded algorithms for easy design implementation. Sector erase for flexible upgrades. JEDEC standard compliance. Even 100,000 read/write cycles — the highest reliability available. Guaranteed.

Word has definitely hit the streets about AMD Flash. So pick up the phone and get the whole story on the AMD Flash family. Contact your local AMD sales office, listed below, for our brochures and a complete Flash Data Book. And see for yourself why so many have raised their standards to those of the AMD Flash family.

*Ask for Literature Pack 18X.*

**Advanced Micro Devices**

For more information on the 29Fxxx Flash family, contact your local AMD sales office or sales representative. International Sales Offices: Antwerpen (03) 248 43 00; Frankfurt area (06172) 9267-0; Hong Kong 86 54 525; London area (0483) 740 440; Manchester area (0925) 830 380; Milano (02) 339-05 41; München (089) 45053-0; Osaka (06) 243 32 50;Paris (1) 49 75 10 10; Seoul (02) 784 0030; Singapore (65) 348 11 88; Stockholm (08) 98 61 80; Taipei (02) 715 35 36; Tokyo (03) 334 67 550.

# PC/104™ Embedded PCs


PC/104 expandable PCs are the practical way to embed the PC architecture in space- and power-sensitive applications. By standardizing hardware and software around the broadly supported PC architecture, you can save substantial development costs, risks, and time.

Rugged, reliable, and built for -40°C to +85°C temperature environments, these compact computers go where most others cannot. You'll find that our embedded PCs and assorted PC/104 modules offer you a standard PC-compatible platform at a fraction of the cost of a custom design with additional features.

The ultra-compact PC/104 modules can be stacked atop each other or as a mezzanine bus on a larger embedded PC. WinSystems offers both busless embedded single board computers with PC/104 expansion and also computers with a hybrid of both STD Bus and PC/104 bus support.

**Call or write for a *free* Catalog.**

EMBEDDED-PC PC/104™ MODULES

**WinSystems®**

**CIRCLE NO. 189**

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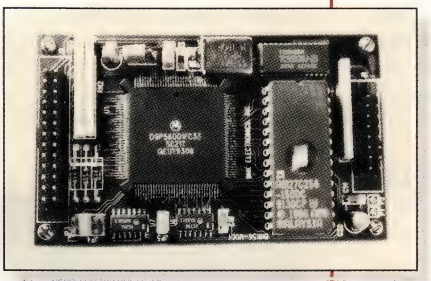
# EDN's 100 Hot Products 1994

**Low-cost FPGA-design starter kits.** Four design kits for FPGAs are available. The $695 Integrator Series FPGA starter kit includes the TI-ALS action logic system with Viewlogic or OrCAD libraries and utilities, the Module Mover, and logic-integration software. The high-end design kit, the FPGA deluxe, costs $4495 and includes schematic capture, PLD-equation entry, simulation, logic synthesis, and a device programmer. **Texas Instruments**, Dallas, TX. (800) 477-8924, ext 4500.
**Circle No. 461**



▲ **DSP56001 development board costs $199.** The MightyMight 56001 (MM56001) development system is based on the BNK56-MOD1 board, which contains a 33-MHz Motorola DSP56001 DSP chip, 96 kbytes of zero-wait-state SRAM, and 32 kbytes of EPROM. The system also includes the BNK56-MOD7 controller module for development. It has an RS-232C interface, which allows communication between the BNK56-MOD1 and the host. It also includes a debugger and a C utility library. In the host-computer/debug mode, the debugger has full control over the DSP. You can view and modify registers and memory, single step, set breakpoints, and download code. **BNK Electronics Inc**, Englewood Cliffs, NJ. (201) 894-5905.
**Circle No. 462**

**Miniature 8W dc/dc converters are 100% burned in.** The 800 series of 8W dc/dc converters is 100% burned in for 72 hours. The units' six-sided metal case measures 1×2×0.375 in. They operate over a –30 to +71°C range with no derating or heat sinking. The series features 5, 12, and 15V outputs in single-, double-, and triple-output models. The units also have input filters and remote on/off control. $58 to $66.50. **Conversion Devices**, Brockton, MA. (508) 559-0880.
**Circle No. 463**

**DIP converters output 1W.** D-3 dc/dc converters output 1.2W (1W for the 5V output models). Housed in a DIP-type package measuring 0.5×0.4 in., the units accept inputs of 5, 12, 15, or 24V and output 5, 9, 12, 15, 24, ±5, ±12, or ±15V. Output voltage accuracy equals ±5%, and total output ripple and noise measures 150 mW p-p max. Operating range spans 0 to 70°C. $18.75 and $19.75 for single- and dual-output models, respectively. **Alban Inc**, Santa Clara, CA. (408) 988-3949.
**Circle No. 464**

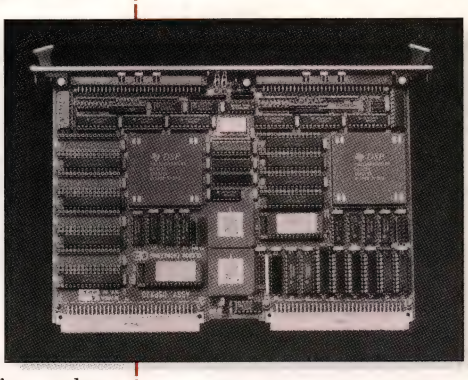
**Silvered-mica snubbers quash 100,000-V/μsec transients.** The Snubber Mike line of silvered-mica capacitors handles 3.7-kA peak currents and 8.7A steady state. These units exhibit unmeasurable changes in capacitance over frequency and temperature and withstand millions of "shots" without degrading. Capacitances range from 100 pF to 0.01 μF, and voltages range from 500 to 1.5 kV dc. $0.15. **Cornell Dublier**, New Bedford, MA. (508) 996-8564.
**Circle No. 465**

**Voice chip attains consumer pricing.** The ISD1100 is a solid-state analog record and playback device that stores 10 sec of sampled audio. Because it stores the audio as analog charge levels in EEPROM, the device does not need A/D conversion. It contains input and output preamplifiers, AGC, and filters on-chip. $5.48 in DIPs; $4.18 as bare die (1000). **Information Storage Devices**, San Jose, CA. (800) 332-8638.
**Circle No. 466**

**ICs drive optocouplers or serve as power-supply front ends.** The UC39431 and UC39432 ICs contain an accurate voltage reference, a high gain-bandwidth error amplifier, and a linear-transconductance output-stage current source. In optocoupler applications, the linear transconductance amplifier replaces a common-emitter transistor amplifier, which has inherent nonlinear characteristics, to provide accurate control of the LED current. The UC39431 also includes three precision, low-temperature-coefficient resistors, which you connect to provide one of six regulated output voltages. An external resistor programs the UC39432's transconductance amplifier, allowing a more stable design in closed-loop optocoupler-feedback applications. $1.25 (1000). **Unitrode Integrated Circuits Corp**, Merrimack, NH. (603) 424-2410.
**Circle No. 467**

**Audio IC handles 16-bit stereo.** Offering all the functions of the Sound Blaster Pro except FM synthesis, the 82C928 costs just $15 (1000). The device offers interfaces for the Windows Sound System, the AT bus, the OPL-3 and -4, and MIDI. It also has a CD-ROM-drive interface and handles 16-bit data at a 48-kHz data rate. **Opti Inc**, Santa Clara, CA. (408) 980-8860.
**Circle No. 468**

**MPEG audio decoder fits in small package.** The SAA2500 MPEG decoder complies with MPEG Layers 1 and 2 and automatically conforms to the audio data rate. It also demultiplexes ancillary data in the audio bit stream. The device has selectable output-data precision from 16 to 22 bits and provides automatic de-emphasis of the decoded audio. Sample cost is $25. **Philips Semiconductors**, Sunnyvale, CA. (800) 447-1500, ext 3000.
**Circle No. 469**



▲ **VME board offers multiprocessor capability.** Based on dual TMS320C40 DSP chips, the DSP220 6U VME board offers 80 Mflops of peak processing power. Each processor has 128 kbytes of EPROM and a 2k×16-bit dual-ported SRAM along with zero-wait-state program memory. The communications ports on the C40 connect to the VME P2 connector. $5495. **Olsson Research Inc**, Edmonds, WA. (206) 778-9480.
**Circle No. 470**

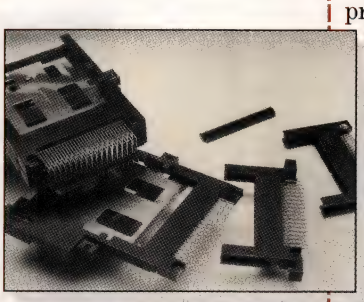
# EDN'S 100 HOT PRODUCTS 1994

**Tiny video system transmits long distances.** The PC-7 video system, which comprises three small boards and a 2.7-oz color video camera, fits in small spaces and can transmit without wires as far as 10 mi. The boards are connected by flexible ribbon cable and can be arranged in different configurations. The smallest configuration is a 2.25-in. cube. Camera, $370; transmitters start at $50. **Supercircuits**, Austin, TX. (512) 335-9777. **Circle No. 471**

**Wireless data link connects computer equipment.** A pair of transceiver units known as Comrad enables a computer to communicate wirelessly with another computer or with peripheral equipment. The units connect to RS-232C ports and operate on the 900-MHz radio band. No FCC license is necessary. $429.95. **Communications R&D Corp**, Indianapolis, IN. (317) 290-9107. **Circle No. 472**

**Digital-coupler IC replaces optocouplers.** The ISO150 uses high-voltage capacitors instead of an LED and photodiode to transmit signals across the isolation barrier. This alternative device to high-speed optocouplers offers faster performance, lower power consumption, and better isolation specifications. The coupler also acts as a transceiver, whereas optocouplers are unidirectional. Primary applications include digital isolation for A/D and D/A conversion, multiplexed data transmission, and I/O-port isolation in instruments. The IC requires no external components. Key specifications include an 80-Mbps typical data rate, 25-mW max power consumption per channel, 2400V-rms isolated partial discharge, and 16.5-mm creepage distance. In a 24-pin DIP, $7.75 (1000). **Burr-Brown Corp**, Tucson, AZ. (602) 746-1111. **Circle No. 473**

**Featherweight PC needs only 50 mW.** The uVG25 PC-compatible module measures 52×80 mm and consumes 50 mW at 5V. The module uses two 50-pin connectors for interface to your system; it offers 32 parallel I/O lines, two serial channels, and a real-time clock. The module's processing core includes a 10-MHz V25 processor and as much as 1 Mbyte of memory. From $120. **Skylake Talix**, Southampton, Hampshire, UK. (44) 703-666403. **Circle No. 474**

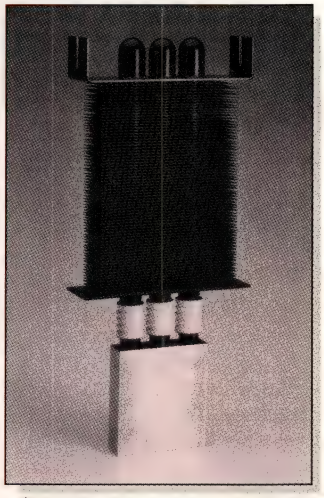


▲ **PCMCIA sockets and plugs adopt various orientations.** A line of PCMCIA sockets and plugs suits traditional horizontal as well as vertical orientation. Through-hole and surface-mount versions are available. Standard options on most plugs include left- or right-hand ejector buttons, electrostatic-discharge clips, and locking clips. An 88-pin plug for DRAM cards is also available. $0.041 per pin for sockets and $0.037 per pin for plugs. Delivery is five working days ARO. **Samtec**, New Albany, IN. (812) 944-6733. **Circle No. 475**

**System adds cellular connection to PCs.** The Ubiquity 2000 attaches to a mobile computer via a serial port and provides a range of voice and fax cellular-communication services. It transfers wireless data over cellular-digital-packet-data (CDPD) or circuit-switched cellular systems. The system permits clear, wireless voice and data communication inside buildings and in fringe areas. $1595. **Pacific Communication Sciences Inc**, San Diego, CA. (619) 535-9500. **Circle No. 476**

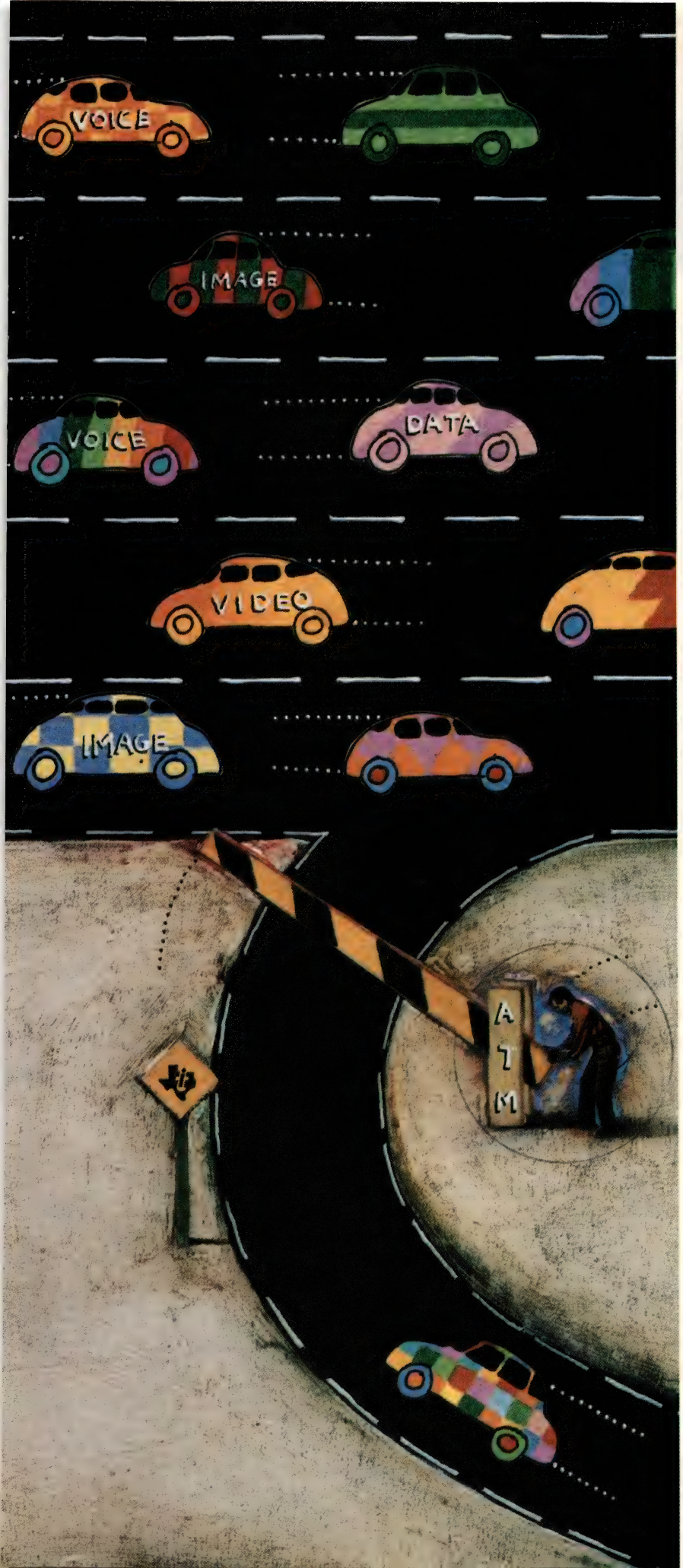
**Fuzzy-logic design and simulation tool offers increased capability.** CubiCalc 2.0 offers a variety of improvements over the previous version. Those improvements include control over each step of the fuzzy inference process, 3-D-decision surface-display plots, and array-variable support for complete system simulation, including nonfuzzy computations. CubiCalc 2.0 costs $495; an upgrade from the previous version costs $100. The programmers version, CubiCalc RTC 2.0, costs $795, and an upgrade costs $150. **HyperLogic**, Escondido, CA. (619) 746-4089. **Circle No. 477**

**Embed your state diagram.** Many embedded systems can benefit by using finite-state machines (FSMs). However, the best way to develop and describe an FSM is with state diagrams. But then you must embark upon the tedious conversion of the FSM into working code. BetterState software from R-Active now solves that problem by generating code for you once you design the FSM. BetterState generates C, C++, VHDL, or Verilog HDL code. The program allows you to input your state diagrams via graphical images on an IBM PC running Windows. BetterState allows for hierarchical design; that is, to simplify design and visualization, you can include many states into one higher level state. The software also detects race conditions, detects design errors, and creates clear listings. You can select an if-then-else or a table method of code generation. $1195. **R-Active**, Cupertino, CA. (408) 252-2808. **Circle No. 478**



▲ **Heat-pipe heat sinks cool power semiconductors.** A line of heat-pipe heat sinks uses a non-ozone-depleting fluid. The heat sinks suit outside-traction applications. Standard models are available for semiconductor devices up to 3.94 in. in diameter and dissipate up to 3000W. Models with thermal resistances as low at 0.01°C/W at 10-ft/sec airflow are available. $260 (1000). **Thermacore Inc**, Lancaster, PA. (717) 569-6551. **Circle No. 479**

**Single-board computer runs Basic.** Based on the 8032 processor, the ANC-

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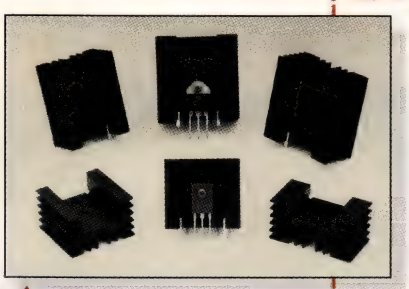
CIRCLE NO. 108

3052B module allows designers to create applications programs in Basic. The module offers a 32-kbyte RAM bank and sockets for as much as 64 kbytes of PROM in addition to the Basic interpreter in ROM. The board includes two external interrupts, two counter/timers, and eight digital I/O lines, along with a 20-pin adapter that can be wire-wrap configured to meet the I/O signal's pinout needs. The board costs $198; it's available without Basic for $146. **Antona Corp**, West Los Angeles, CA. (310) 473-8995.

**Circle No. 480**



**▲ Heat sinks cool TO220, 218, TO3-P, and multiwatt devices.** A family of 1.65- and 2-in.-wide heat sinks mounts vertically and provides a threaded mounting hole. You can mount the heat sinks with tin-plated solderable studs or screws. $1 (1000); delivery is three to four weeks ARO. **International Electronic Research Corp**, Burbank, CA. (213) 849-2481.

**Circle No. 481**

**ATM comes to VME systems.** By connecting to a DS3 telephone service, the CVME901 board brings asynchronous-transfer-mode (ATM) communications to VME systems. The board offers a hardware-based ATM adaptation layer (AAL) that handles packet segmentation and reassembly for service categories AAL 3/4 and AAL5. An on-board i960 processor handles congestion control, error checking, and the host interface. The board's DMA controller handles data at rates to 48 Mbytes/sec, ensuring that the board can handle communications traffic at the DS3 link's full speed. $4597 (100). **Cyclone Microsystems**, New Haven, CT. (203) 786-5536.

**Circle No. 482**

**NiMH batteries hold 40% more juice than NiCd batteries.** The DR19 and DR31 nickel metal-hydride (NiMH) batteries last 40% longer than comparably sized NiCd batteries. The DR19 is a 10.8V, 1500-mAhr battery in a 9×4/5A package. The DR31 is a 10.8V, 2400-mAhr battery in a 9×4/3 A package. DR19, $99; DR31, $169 (retail). **Duracell International Inc**, Bethel, CT. (203) 796-3281.

**Circle No. 483**

**▲ PTC thermistors make dandy self-regulating heaters.** Positive-temperature-coefficient (PTC) thermistors combine a heater and thermostat in one ceramic material. Because of their high temperature coefficient of resistance, these devices respond to temperature changes by automatically adjusting their power dissipation, maintaining a nearly constant body temperature over a wide ambient-temperature range. Configurations include chips and disks with no leads as well as special configurations with patterned holes. An application note is available. Standard devices cost $0.20 to $1 in large quantities. **Keystone Carbon Co**, St Marys, PA. (814) 781-4444. **Circle No. 484**

**Tiny four-channel data logger accepts plug-in signal conditioners.** The self-configuring, battery-powered MicroDataLogger accepts signal conditioners for temperature, humidity, pressure, light level, ac and dc current, power, luminance, occupancy, and rotational velocity, among other parameters. The logger stores 16,000 12-bit readings per channel. An internal real-time clock time-stamps the data. <$1000. **Architectural Energy Corp**, Boulder, CO. (303) 444-4149.

**Circle No. 485**

**Tiny black-and-white TV camera comes on a single chip.** The V-007's camera IC measures 0.55×0.42 in. A complete camera assembly in an aluminum case and bearing a 4-mm lens measures 1.37 in. square. The IC has a 312×287-pixel image-sensor array. Pixel size is 19.6×16 µm. Automatic exposure range is 40,000:1, and AGC is adjustable to –10 dB. The camera is sensitive into the infrared. A demo unit operates from a 9V battery and plugs directly into any type of monitor. $249. **Marshall Electronics Inc**, Culver City, CA. (310) 390-6608.

**Circle No. 486**

**Inverter stage integrates all power components for 1-hp motor drive.** The MHPM7A15A60 hybrid power module integrates a 3-phase input rectifier bridge, a 3-phase output inverter, a brake transistor-diode, an optional current-sense resistor, and a temperature sensor on its insulated metal substrate (IMS). The 600V, 15A module drives 1-hp (750W) or smaller motors to bring intelligent motor control down to office equipment and household appliances. The output inverter uses matched IGBTs and freewheel diodes. Other features include access to both positive and negative dc bus and a single-phase ac-input option. $50 (100). **Motorola Semiconductor Products Sector**, Phoenix, AZ. (602) 244-3103.

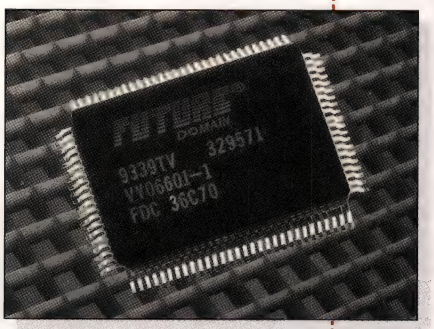
**Circle No. 487**


**▲ Nickel metal-hydride cell is available in "prismatic" form.** The model HHF80T nickel metal-hydride (NiMH) cell comes in rectangular, or "prismatic," form, permitting more densely packed batteries than possible with cylindrical cells. The cells measure 17 mm long×6.1 mm wide×67 mm high. The cells have a nominal output voltage of 1.2V and a nominal capacity of 760 mAhr. $8 (500 to 1000). **Panasonic Industrial Co**, Secaucus, NJ. (800) 848-3979.

**Circle No. 488**

**Camera IC digitizes images on chip.** The ASIS-1070 CMOS IC

integrates a 160×160-pixel photodiode image-sensor array with enough active circuitry to produce an automatic-exposure camera. You can select video output in analog mode, complete with synchronization pulses, or in digital mode as 8-bit parallel or as serial data. The IC operates with a frame rate of 0.5 to 24 frames/sec. The effective image-array size is 1.68×1.68 mm, and you can select from four image formats of 120×120, 120×160, 160×120, or 160×160 pixels. Additional on-chip automatic black-level calibration maintains image stability without external components. The IC consumes less than 100 mW of power and comes in a 44-pin PQFP. $10 (10,000). **VLSI Vision Ltd**, Edinburgh, UK. (31) 539-7111. **Circle No. 489**



**One chip and two plug-in cards connect SCSI-2 to the PCI bus.** A single 32-bit chip takes advantage of the PCI local bus to connect directly to a SCSI-2 bus. The 36C70 provides an internal 2-kbyte FIFO buffer that facilitates synchronous 10-Mbyte/sec data-transfer rates. The chip comes in a 100-pin metric quad flatpack and is pin-compatible with NCR's 53C810 chip. However, unlike the NCR chip, which requires add-in drivers, the 36C70 provides built-in support for the operating system. The 36C70 has four functional blocks: SCSI, a PCI interface, a FIFO buffer, and a serial ROM interface. The chip complies with the PCI 2.0 specification. The company also offers two PCI-to-SCSI cards based on the 36C70 IC. The TMC-3260 card features active and autotermination, which lets the card automatically sense if the SCSI card resides in the middle of the SCSI bus and disables termination. The card has SCSI-2 50-pin internal and 50-pin external connectors. The TMC-3260-MEX card operates in applications that integrate the SCSI ROM BIOS into the PCI BIOS or that do not require a boot ROM. The 36C70 costs less than $20 (OEM). The TMC-3260 costs $259. **Future Domain Corp**, Irvine, CA. (714) 253-0400. **Circle No. 490**

**800V half-bridge driver comes in single IC.** The PWR-INT100 is an 800V, half-bridge driver IC that interfaces between 5V control logic and MOSFETs driving high-voltage, 2-hp, brushless dc motors at rates up to 50 kHz. The IC incorporates a lockout for full-bridge implementation, which prevents both high- and low-side transistors from turning on simultaneously. The drivers sink 300 mA and source 150 mA. $1.76 (1000). **Power Integrations Inc**, Mountain View, CA. (415) 960-3572. **Circle No. 491**

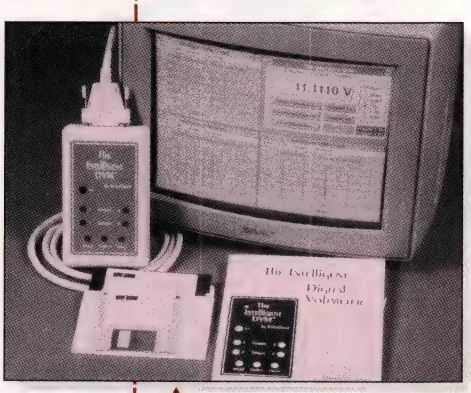
**Red and green LEDs are sunlight-visible.** The red SLA-570 LED provides a luminous intensity of 2400 mcd at 10 mA, and the green version emits 750 mcd, both exhibiting a 24° viewing angle. The units have 100,000-hour MTBF. Green LED, $0.07; red LED, $0.125 (10,000). **Rohm Corp**, Antioch, TN. (615) 641-2020, ext 121. **Circle No. 492**

**Toroidal power transformers optimize efficiency and power-to-weight ratios.** The Toro transformer line has power ratings from 10 VA to 8 kVA. A 100-VA model weighs 1.9 lbs and has an efficiency rating of 86%. The transformers are UL1411-listed. The units have a self-contained mounting scheme that eliminates external brackets. $12 (OEM); delivery four to six weeks. **Amecon Inc**, Anaheim, CA. (714) 634-2220. **Circle No. 493**

**Zener diodes come in surface-mount package.** The RSZ5200 series of zener diodes comes in SOT-23-style packages. Zener voltages range from 2.5 to 51V, and power dissipation is 225 mW. The devices' operating range is –55 to +150°C. $0.04 (1 million). **Rohm Corp**, Antioch, TN. (615) 641-2020, ext 134. **Circle No. 494**

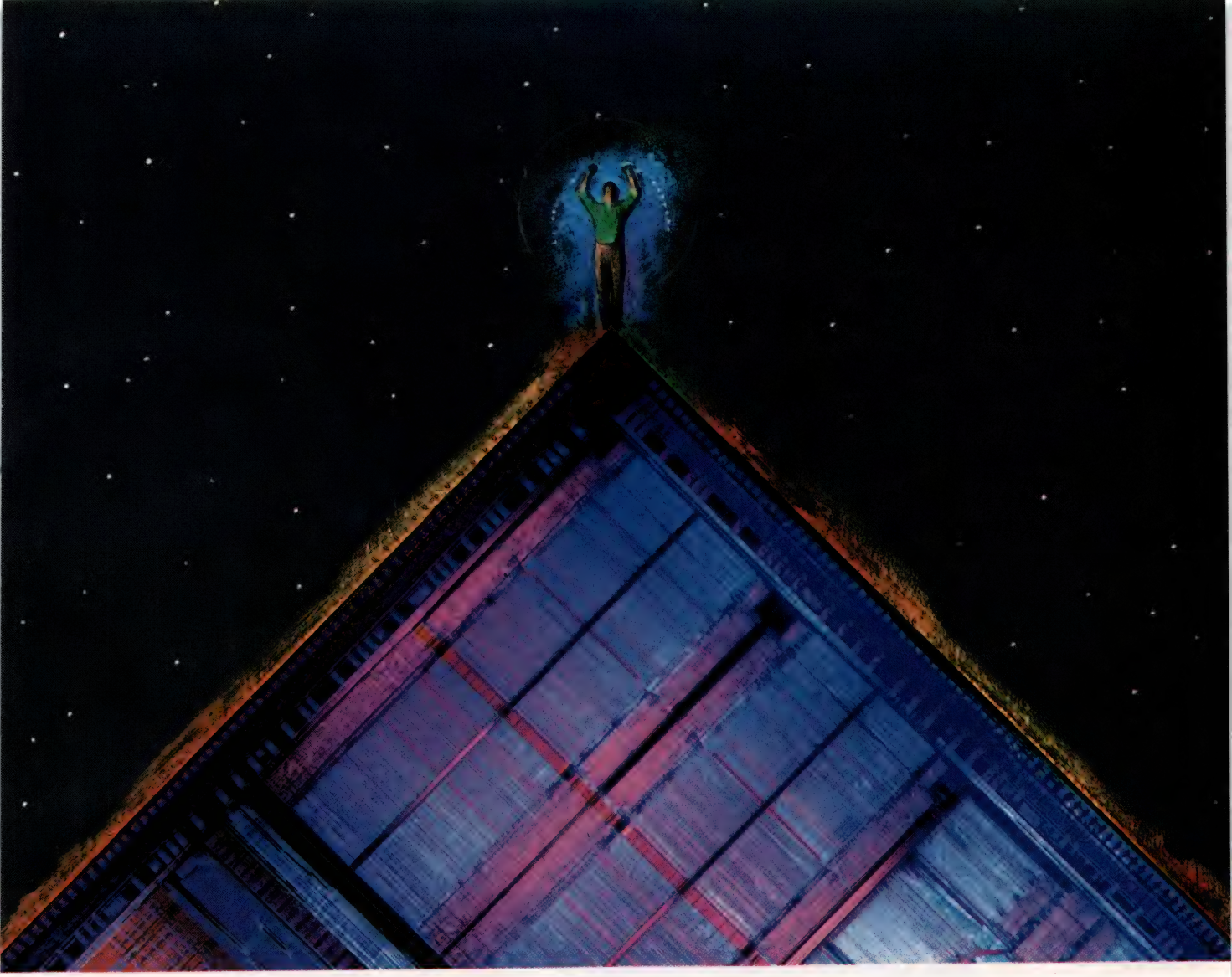
**Extender card allows live board insertion.** The Smart Extender board series isolates all signal and power connections to a board under test under an on/off-switch control. It ramps power voltages when activated, which prevents power spikes, and automatically daisy-chains signals to the next slot when deactivated. It includes resettable fuses on the power lines and a built-in current monitor. The board adds <1-nsec delay to signal lines. VME and PC/AT bus versions available. From $795 (VME). **Catalyst Enterprises Inc**, San Jose, CA. (408) 268-4145. **Circle No. 495**

**5½-digit DVM attaches to PC's parallel port.** Unlike classical handheld meters, the 1.41×3.75×6.3-in. Intelligent DVM includes no display; it uses your PC to present its readings. The $299.95 autoranging unit (1-



range version, $239.95) offers an error of ±0.01% of full-scale-range (FSR) and a ±0.015% FSR/°C temperature coefficient. A $339.95 unit reduces errors by 40% and is 1/10 as sensitive to temperature. On the most sensitive range, the units resolve 100 nV; the least sensitive FSR is ±200V. A differential multiplexer scans eight inputs; there are two digital outputs. Conversion speed is 13 readings/sec. Windows-based software provides full control; it converts readings to engineering units and displays data as numbers or graphs. **Delta Quest**, San Jose, CA. (408) 997-8644. **Circle No. 496**

**VME board harnesses PowerPC CPU.** The VMTR2 and the VGPW2, first



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# Clip and Save!

| No. | Product | Series | Type | Samples | Typical Circuit |
|---|---|---|---|---|---|
| 1 | Solid Chip Suppressor | NZ | 1608 | | |
| | | | 2012 | | |
| | | | 3216 | | |
| | | | 4516 | | |
| | | | 5750 | | |
| 2 | Inductor | NW | 2520 | | |
| | | | 5650 | | |
| 3 | Common Mode Choke | M | 520 | T520 | |
| | | | 530 | | |
| | | | 540 | TOKIN M-540C 73 | |
| | | CZ | 5745 | | |
| | | TZ | 5745 | | |
| 4 | Leadless Power Inductor | P•I-Z | 9×7×5 | | |
| | | | 12×10×6 | | |
| | | P•I-L | 9×7×5 | | |
| | | | 12×10×6 | | |
| 5 | 3-Terminal Noise Suppressor | E-T | 4525 | | Noise source |
| 6 | 3-Terminal Chip Capacitor | E-C | 3216 | | Input Output |

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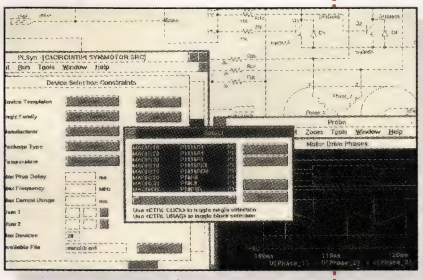
**Tokin Europe GmbH**
Knorrstr. 142, 80937 München, Germany
Phone: 089-311 10 66 Fax: 089-311 35 84

models in the PowerEngine family of single-board VME computers, use the IBM PC601 as a core processor. The boards run the UNI/X, UNI/RT5, and AIX RISC System 6000 operating systems; they operate at 50- or 66-MHz clock speeds and come with 16 Mbytes of memory. From $6000. **Cetia**, Toulon, France. (33) 94.08.80.00. **Circle No. 497**



**Mixed-signal design tool adds programmable logic.** Using one tool, you now can design and simulate a system that includes programmable logic and discrete digital and analog parts. PLSyn, a new member of Microsim's Design Center family, adds the programmable-logic capability. You can describe the programmable-logic design directly on the schematic (along with other analog and digital devices); use a synthesis language or logic symbols; or combine both methods. The software accommodates hierarchical designs with tens of thousands of gates. PLSyn lets you simulate designs, before and after physically implementing the programmable logic, using either timing estimates or timing data from the actual device implementation. You can run the simulation on either PLogic (for completely digital designs) or on PSpice A/D (for mixed analog/digital designs). The Design Center's integrated environment provides interactive stimulus editing and graphical waveform analysis. Design Center with PLSyn costs $3500 to $5500 ($4550 to $7150 internationally) for use on PCs under Microsoft Windows, and $7600 to $14,500 ($9900 to $18,850 internationally) for use on Sun workstations under Open Windows. **MicroSim**, Irvine, CA. (714) 770-3022. **Circle No. 498**

**Updated motherboard boosts speed.** The Leopard 486 SLC2/66 PC motherboard—a 66-MHz version of a 33-MHz predecessor—allows operation at rates as high as 19.3 MIPS. The board's external-bus speed remains at 33 MHz, but the resident IBM 486SLC2 μP operates at 66 MHz and has a 16-kbyte internal cache. Two VESA local-bus slots allow direct processor access to high-performance peripherals. $399. **Alaris Inc**, Fremont, CA. (510) 770-5700. **Circle No. 499**

**Timing-driven FPGA design from synthesis to layout.** Neocad's High Level Design Link software for its FPGA Foundry 4.1 program links with Synopsys's logic-synthesis tools to let you create designs that meet your timing and frequency requirements. You specify those requirements at the hardware-description-language (HDL) level, and the software automatically places and routes a design to meet those requirements, if possible. The software supports Xilinx 4000-family FPGAs. Prices for High Level Design Link start at $2500. FPGA Foundry 4.1 also provides design support for Motorola's MPA1036 FPGA, starting at $3995. FPGA Foundry 4.1 includes Prism, an FPGA partitioning tool that maintains timing performance across multiple FPGAs. The tool lets you focus on system design and functional details instead of the size of logic blocks and how they are implemented in an FPGA. The Prism partitioning module starts at $3995. **Neocad**, Boulder, CO. (303) 442-9121. **Circle No. 500**

**Temperature sensor outputs digital number.** The DS1620 digital thermometer and thermostat converts a temperature reading to a 9-bit digital number in less than 1 sec. The sensor does not require external digital devices, such as A/D converters. The factory-calibrated unit has a 0.5° resolution over the –55 to +125°C temperature range. Two user-definable setpoints allow the unit to operate as a thermostat. The thermostat stores test points in nonvolatile memory. $2.50 (5000). **Dallas Semiconductor**, Dallas, TX. (214) 450-0448. **Circle No. 501**

**Free demo disk aids visual programming.** Two demo programs show how to use the DT VEE and VB-EZ visual-programming tools. DT VEE lets you create data-acquisition programs via visual programming. VB-EZ works with Visual Basic to prototype data-acquisition applications rapidly. **Data Translation Inc**, Marlboro, MA. (508) 481-3700. **Circle No. 502**

**Chip gauges battery charge.** The MTA11200 monitors and digitally integrates both charge and discharge currents for a battery, providing a real-time estimate of active battery capacity. The device also senses and compensates for self-discharge effects when a battery pack is not in service. Its calculations of capacity remaining include compensation for temperature, discharge rate, and battery type. $3.75 (10,000). **Microchip Technology**, Chandler, AZ. (602) 786-7200. **Circle No. 503**

**Handheld LCD DMM/DSOs display transient waveform anomalies.** TekMeters are handheld, battery-powered DMM/digital storage oscilloscopes (DSOs) with LCDs. The $859 THM 550, with its single DSO channel, includes one of the custom ICs. The $999 THM 560 and $1259 THM 565—both of which offer two DSO channels—include two of the chips. (The THM 565 has a backlit display and more features than the other two models.) When you power up one of the units, it behaves as a 4000-count true-rms DMM that offers such functions as resistance measurement to 40 MΩ, an audible continuity indication, and a diode-check mode. Pushing one button

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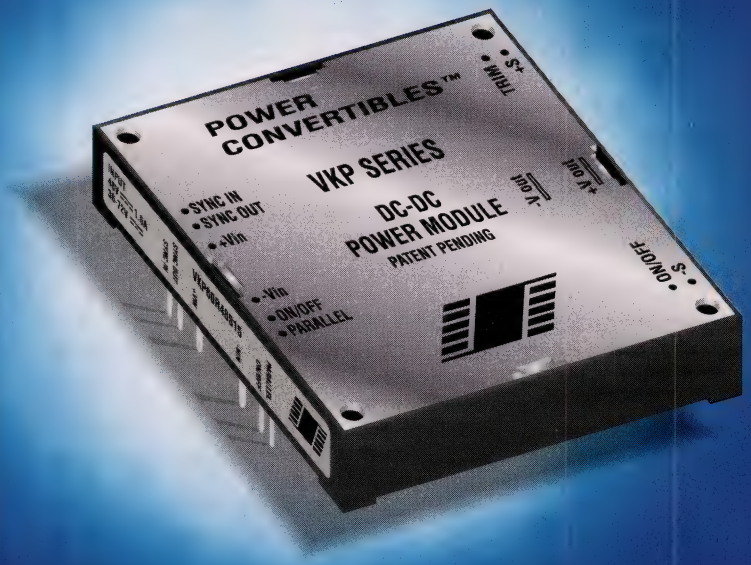


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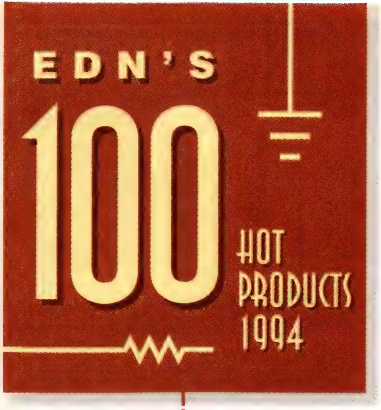
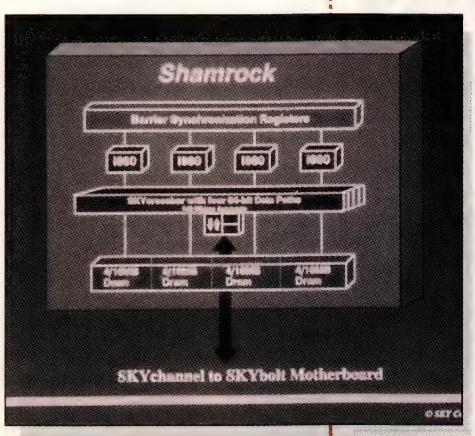



turns on the DSO function. The DSO bandwidth is 5 MHz; each DSO channel can acquire 25 Msamples/sec in real time. The two-channel models sample simultaneously. Six alkaline AA cells power the units for four hours. You can also use rechargeable cells. **Tektronix Inc**, Beaverton, OR. (800) 426-2200. **Circle No. 504**

**Huge DSP chip combines four processors.** Following the pattern of many DSP-board manufacturers that are incorporating multiple processors into their designs, Texas Instruments is now duplicating that trend in silicon. The MVP processor (TMS320C80) combines four 32-bit integer DSPs, a 32-bit RISC processor, and a 100-Mflops floating-point unit into a ¾-in.-sq device. MVP includes 50 kbytes of SRAM, a transfer controller, and a video controller. Its transistor count is nearly 4 million, and its combined processing power exceeds 2 billion operations/sec. To achieve this density, TI uses a 305-pin ceramic pin-grid array and the same 0.5-µm process that it uses for 16-Mbit DRAMs. The TMS32C080 is in sample production until early 1995, when full production will be available. When in full production, the device will cost $300 to $400. **Texas Instruments**, Houston, TX. (800) 477-8924, ext 4500. **Circle No. 505**

**Lithium thionyl-chloride cells run for 15 years continuously outdoors.** Eternacell lithium thionyl-chloride cells have an open-circuit voltage of 3.65V and capacities ranging from 0.9 to 30 Ahr. Cell sizes include ⅔A, ½AA, AA, C, D, and DD. The cells are hermetically sealed in stainless-steel cases and have a 15-year outdoor service life min. ⅔A, $4.97; DD, $17.95 (1000). **Power Conversion Inc**, Elmwood Park, NJ. (800) 452-1211. **Circle No. 506**

**Sponge-metal NiCd cells deliver 80% more juice than conventional NiCds.** The SM80 ⅘A cylindrical NiCd P130ASJ cell has a 1.3-Ahr capacity. You can recharge the cell in an hour. $2.50 (1000). **Panasonic Industrial Co**, Secaucus, NJ. (800) 848-3979. **Circle No. 507**




**Module and bus bring 320-Mbyte/sec I/O to VME.** SkyChannel bus architecture allows numerous processors to share access to system resources at data rates as fast as 320 Mbytes/sec. To maximize bus utilization, the synchronous 64-bit bus uses centrally arbitrated packetized data transfers with buffering at each end. Designed for multiprocessing applications, SkyChannel bus allows as many as 4096 processors to be interconnected. Each processor accesses memory and other system resources as part of a 16-Tbyte address space. Thus, the processors can share all memory, which simplifies data exchange. Various SkyChannel products are available from the bus designers. Each uses the Shamrock II compute daughter card as its basis. The Shamrock II offers four i860 processors and 128 Mbytes of DRAM connected by a four-channel bus with crossbar switch. A link to external SkyChannel buses is one of the card's resources. The Skybolt II 6U VME card accepts one Shamrock daughter card and links the SkyChannel bus to the VME backplane's P2 connector. At the system level, the SkyStation II holds two daughter cards and provides them with 512 Mbytes of bulk memory, high-speed parallel I/O, and a SCSI-2 port. The SkySystem is a 500W VME64 chassis with SkyBolt boards, tape, disk, and CD-ROM drives, color monitor, keyboard, and software tools. For designers building their own systems, the SkyBridge interconnect plugs onto the P2 connectors to provide a four-channel bus between boards. The Skybolt II 6U card and SkyStation II system cost $20,000 each. The SkyBridge, Skybolt II 9U cards, and SkySystem products cost $30 to $50k, depending on configuration. The SkyBridge interconnect costs approximately $600/board. **Sky Computers Inc**, Chelmsford, MA. (508) 250-1920. **Circle No. 508**

**External supply meets UL544.** These medical power supplies, designed as desktop adapters, operate from a 90 to 264V-ac input and develop a 12V at 2A output, which is fully regulated. The units meet the 100-µA leakage requirement for patient-connected grounded equipment, as well as UL544 and IEC601-1 requirements. The supplies also feature protection from overloads, short circuits, and overvoltage transients. Operating range spans 0 to 40°C. $39 (1000). **Top-Link Computer**, Milpitas, CA. (408) 946-7888. **Circle No. 509**

**$99 buys 68HC11 proto board with Basic, Forth, C, assembler.** For $99, you can play with the Motorola 68HC11 8-bit µC using Forth, C, Basic, or assembly languages. New Micros' NMIT-0020 integrates a 68HC11 with 0.5 kbytes of EEPROM, 8 kbytes of RAM, LCD/keypad interfaces, battery backup, and sockets for 8 to 32 kbytes of RAM/EPROM/ROM/EEPROMs. Forth resides in µC ROM (can be disabled). The board comes with Motorola Small C, Basic, and assembler, all ported to the board for easy start-up. $99. **New Micros Inc**, Dallas, TX. (214) 339-2204. **Circle No. 510**

**Ready-to-run 8051 system with compiled Basic.** The Universal Dallas Development board combines the RAM-backed Dallas Semiconductor 8-bit 8051 soft microcontroller with a prototyping board and a compiled Basic development system. All you need is a keypad and an LCD for a complete system. The board has an RS-232C port, a serial printer port, a 4×4-key keypad interface, a 4- or 8-bit LCD interface, an 8-bit ADC, and four 300-mA, 12V relay-driver outputs. $199. **Systronix**, Salt

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Lake City, UT. (801) 534-1017. **Circle No. 511**

**Get a glimpse of the future of programming.** This demo package of the LabView for Windows graphical programming software is extremely fun to use. More important, it gives you an idea of how you will program embedded systems in the future. Free. **National Instruments**, Austin, TX. (512) 794-0100. **Circle No. 512**

**Learn how to use low-pin-count μCs.** This evaluation package includes the hardware and software to assemble, simulate, and evaluate the 68HC705 μC. It also includes an introductory guide to using μC and some sample code. If you've ever wanted to play with a μC, here's your chance. 68HC705KICS, $168.05. **Motorola Inc**, Austin, TX. (512) 891-2035 or contact your nearest Motorola distributor. **Circle No. 513**

**Lithium primary batteries are thin enough to fit in PCMCIA cards.** Powerdex lithium primary batteries furnish 3 or 6V outputs yet measure 0.7 mm thick. Units come in 6.6×9.4-, 4.6×7.4-, and 3×3.9-cm sizes. Capacities are 50 to 1400 mAhr. You can solder the batteries' coplanar side tabs directly to a pc board. **Gould Electronics Inc**, Eastlake, OH. (800) 722-7890. **Circle No. 514**

**2-oz handheld device pinpoints sources of EMI.** ScanEM is a near-field EMI tracer that locates electromagnetic-emission hot spots from 30 MHz to 1 GHz. The battery-powered unit, whose $129.95 suggested price includes batteries, has no trailing power cord. **Credence Technologies Inc**, Santa Cruz, CA. (408) 459-7488. **Circle No. 515**

**Type II PCMCIA card holds 16-channel ADC.** The 5-mm-thick, DaqCard-700 includes a 16-channel ADC, 16 digital I/O lines, and three 16-bit counter/timers. The device takes 80k samples/sec. You can configure it for input ranges of ±10, ±5, or ±2.5V. The card works in notebook PCs. The vendor provides software support in its LabView, LabWindows, and LabWindows/CVI packages. $695. **National Instruments Corp**, Austin, TX. (512) 794-0100. **Circle No. 516**

**Kit evaluates low-power applications.** Based on the Motorola 68HC11E9 μC,

▲ the M68-EBLP11KIT consists of an evaluation board, development code, a low-power-design manual, technical documentation, extra crystals, and batteries. The evaluation board contains the μC, a 14-character, two-line LCD, an RS-232C interface, low-power LCD driver chips, a wire-wrap area, and a battery holder. The 68-HC11E9 μC has 512 bytes of RAM and EEPROM, 38 I/O lines, and an eight-channel, 8-bit ADC. A typical application runs from two weeks to a month using batteries. If you often use standby mode, battery life can last up to two months (full out, without any standby, reduces battery life to 30 to 40 hours). You can also power the board with a regulated power supply (2.7 to 5.5V dc) or unregulated power (7.5 to 15V dc). By changing clock frequency, you can experiment with clock-speed tradeoffs. Preprogrammed into the 12-kbyte ROM on the μC is a monitor program called BUFFALO, which includes a debugger and a one-line assembler/disassembler. You can also download assembled code developed on your computer. **Motorola**, Austin, TX. (512) 891-3465. **Circle No. 517**

**8-bit 68HC11C0 targets handheld applications.** Working with Motorola, AT&T has developed a customized 68HC11 as the main controller for some of its mobile and cellular telephones. The μC controls one or more DSP engines as well as peripheral hardware. The resultant μC, the 68HC11C0 runs with external program memory and can access an address space of up to 256 kbytes. It extends the classic 68HC11 64-kbyte space by adding two address lines, which are driven by an address-paging scheme. The external memory bus multiplexes address and data with an 18-bit address and 16 bits of data. The chip provides a full set of peripherals to minimize additional hardware needs. **Motorola, Microcontroller Technologies Group**, Austin, TX. (512) 891-3465. **Circle No. 518**

**Inverters power CCFT backlighting of dual-scan color LCDs.** The L360B series of cold-cathode fluorescent-tube (CCFT) inverters works with the Sharp LM64C08P and the Hitachi LMG972/XUFC dual-scan color LCDs. The inverters measure 120×20×13 mm. and accept inputs from 10.8 to 13.2V dc. Output is 1600V-ac rms for the Sharp LCD and 1300V-ac rms for the Hitachi LCD. Typical output current is 4.8 mA rms. Both inverters offer brightness control. The manufacturer's factory is ISO9001 approved. $20 (OEM). **Xentek Inc**, San Marcos, CA. (619) 471-4001. **Circle No. 519**

**Feature-packed 80C51-type μC includes 10-bit ADC.** The 8XC576, an 80C51 derivative, is a highly integrated controller with a Universal Peripheral Interface and an ADC with 9-bit accuracy. The IC's designers reduced the parts' irradiated noise to ease compliance with FCC standards. Though the IC's EMI/RFI emissions depend on the application, the company claims that the 8-bit μC has reduced emission more than 20 dB in some designs. Additional features include 8 kbytes of ROM/EPROM, 256 bytes of RAM, three 16-bit counter/timers, a programmable counter array, an on-chip watchdog timer, analog comparators, enhanced UART, two PWM outputs, power and oscillator failure detection, user-programmable outputs, and Schmitt trigger inputs. $4.90 (5000). **Philips Semiconductors**, Sunnyvale, CA. (408) 991-5207. **Circle No. 520**

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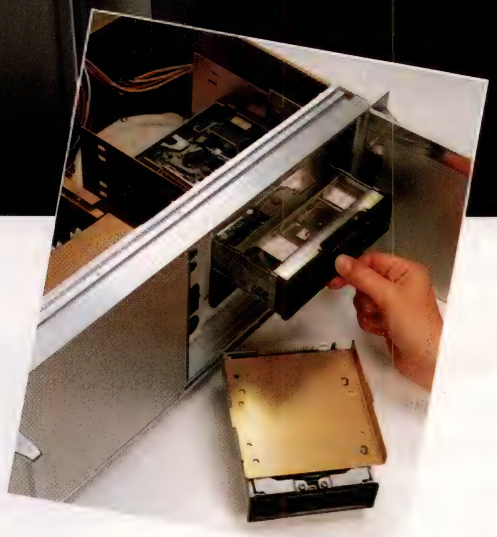

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**Transceiver simplifies SONET/ATM linkage.** To simplify the design of asynchronous-transfer-mode (ATM) systems over the synchronous optical network (SONET), the CY7B951 SONET serial transceiver (SST) has absorbed numerous components formerly needed in SONET physical-layer interface designs. One of the first such components is a line receiver. The CY7B951 device accepts signals from fiber-optic modules, coaxial cable, or twisted-pair interfaces without external buffering. The device also eliminates the need for external components in its PLL designs. Instead, the SST fully integrates the PLLs, including filter components, and the PLLs offer a 10-psec rms jitter. In addition, the PLLs operate at 155.54- or 51.84-MHz SONET frequencies. The SST provides separate PLLs for clock/data recovery and for data transmission. The incorporation of a transmit-clock PLL also allows the receiver PLL to avoid drift in the absence of data transitions. When the carrier-detect input line indicates the loss of receive signals, the receive PLL switches its reference to the transmit clock rather than free-running on no signal. The device comes in a 24-pin SOIC package and costs $45 (100). **Cypress Semiconductor**, San Jose, CA. (408) 943-2600.

**Circle No. 521**

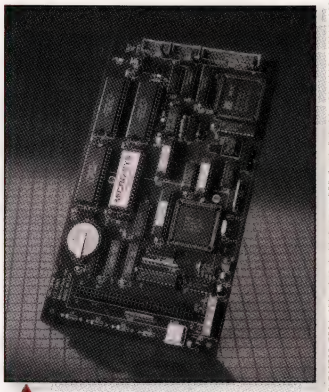
**Tools tame device with four DSPs and RISC μP.** The MVP (Multimedia Video Processor, or TMS320C80) includes four 32-bit DSPs along with a RISC μP that has a floating-point unit, a transfer controller, a video controller, and some common memory. A set of DSP development tools helps you control the chip. The MVP tools include simulators, a debugger, a C compiler, an executive, a library of DSP and multiprocessing primitives, and an algebraic assembler. A device simulator provides a view of the five on-chip processors; you can independently view and manipulate each processor. A system-level simulator lets you verify system performance and compatibility with system devices. An expanding DSP-primitive software library comes with the $30,000 tool kit. **Texas Instruments**, Denver, CO. (800) 477-8924, ext. 4500.

**Circle No. 522**

**800-MHz op amp draws only 5 mA.** The AD8001 current-feedback op amp is the first standard product from Analog Devices' newest high-speed complementary bipolar process. This process produces transistor switching frequencies—2.5 and 4.5 GHz for npn and pnp devices, respectively—that are five times greater than the company's older complementary bipolar process. The process produces ICs that require less power at higher speeds, allows smaller geometry, and fits many more die on one wafer (although at higher wafer costs). What results is a $3.36 (1000) unity-gain amplifier that features a –3-dB bandwidth of 800 MHz, typically drawing just 5 mA of supply current on ±5V supplies. Maximum supply current over temperature is 6.5 mA. In addition to the video characteristics, namely differential gain and phase and gain flatness, other notable specifications include a slew rate of 1200V/μsec and settling time to 0.1% of 8 nsec. **Analog Devices**, Wilmington, MA. (617) 937-1428.

**Circle No. 523**

**Single-board PC includes on-board development firmware.** Often, developing low-end PC-based embedded systems requires that you load various tools into the target



▲ to debug your code. In these applications, a keyboard and video display may not exist on the target. Borland's TDREMOTE, a target-resident utility, allows you to use the company's Turbo Debugger on the target system. The SBC2040 includes firmware that can support Borland's Turbo Debugger. You just connect a cable between the PC and the SBC2040. When you've debugged the program, the unmodified .exe file is burned into EPROM and plugged into the SBC2040. A flash EEPROM package is available for field upgrades. The single-board computer suits diskless applications and includes two serial ports, a parallel port, and a watchdog timer. Onboard memory handles four 32-pin memory ICs, for a total of up to 4 Mbytes of memory. A PC/104 interface and a six-channel 12-bit A/D converter are also included. $275; $75 for the A/D option. **Micro/Sys**, Glendale, CA. (818) 244-4600.

**Circle No. 524**

**Power PC processor comes to VMEbus.** The PowerPC processor architecture has made it to the VMEbus in the form of the MVME160x computer-board family. The boards employ a modular architecture to provide a range of CPU and memory options with a common base. Options include 66- or 100-MHz CPUs and as much as 128 Mbytes of DRAM. The 160x family base boards contain the peripheral devices linked over a 32-bit PCI local bus running at 33 MHz. Peripherals directly on the PCI bus include Ethernet and wide-SCSI-2 ports and an SVGA driver. The CPU, along with its local ROM and secondary cache, plugs into the PCI bus through a socket on the base board. The module can contain either a 66-MHz PC603 processor or a 100-MHz PC604 processor; its design ensures that all high-frequency signals remain within the module and that the CPU remains decoupled from the PCI bus. The MVME160x family comes with extensive software support. The boards come with a five-year parts-and-labor warranty for factory repair. An 8-Mbyte DRAM configuration costs from $3575. The MVME1604 starts at $4575. **Motorola Computer Group**, Tempe, AZ. (800) 759-1017, ext PR.

**Circle No. 525**

**Power-factor correctors need few external components.** In the next few years, US and European regulatory agencies will mandate that a broad range of products incorporate power-factor correction. The LT1248 and LT1249 power-factor

# Byte-wide 16M DRAMs are taking off

## NEC launches high-volume production of x8 and x16 devices

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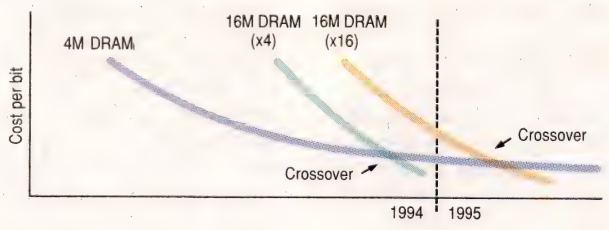


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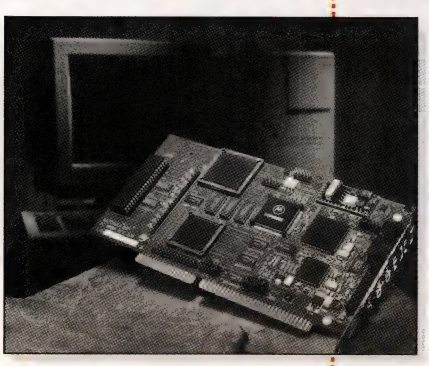
|---|---|---|---|---|---|
| 2M x 8 | 5.0V<br>3.3V | 50, 60, 70, 80 (5.0V)<br>60, 70, 80 (3.3V) | 4K/2K | Fast Page<br>Hyper Page | TSOP II<br>SOJ |
| 1M x 16 | | | 4K/1K | | |

NEC

CIRCLE NO. 114

controllers provide this correction for universal off-line power systems with very few external parts. For a wide range of loading conditions, the ICs achieve a power factor of over 0.99. The ICs use fixed, high-frequency, PWM current averaging and require no slope compensation. The advantage of this approach is that the ICs achieve lower line-current distortion and can use lower-cost switches and magnetics than ICs or systems that rely on either peak-current detection or zero-current switching. Protection features include peak-current limiting and instantaneous overvoltage protection. The LT1248 can operate at frequencies as high as 300 kHz. The LT1249's switching frequency is fixed at 100 kHz, but this IC comes in eight-pin DIPs ($3.19) and SOICs ($3.44); the LT1248 comes in 16-pin DIPs ($3.53) and SOICs ($3.76 (1000)). **Linear Technology Corp,** Milpitas, CA. (408) 432-1900. **Circle No. 526**



▲ **Multimedia development kit includes DSP application software.** PC Media is a software/hardware combination for IBM PC-based multimedia applications. Motorola also offers a development kit that includes a developer's board based on the company's DSP56002 DSP chip. The company is using the 24-bit, fixed-point chip as the DSP engine. The kit comes with sample application software, which runs on the developer's board. The $7500 kit also includes versions of DSP-task software from Motorola and third-party vendors, a C compiler, an assembler linker, reference designs, and documentation. The PC Media kit currently works with a single-task host-based server and a single-task DSP operating system. As such, it allows users to test individual applications. The included task software provides modem, fax, telephone-answering-machine, full-duplex speaker-phone (with echo cancellation), voice-compression, sound synthesis, text-to-speech translation, and .WAV recording and playback tasks. Motorola will add caller-ID, sample-rate-conversion, V.FAST, VSELP, and voice-recognition tasks. **Motorola,** Austin, TX. (512) 891-2030. **Circle No. 527**

**8-bit μC combines 8051 with 64 bytes of RAM.** The 83C750/83C750 integrates the 8051 core processor with 64 bytes of RAM and 1 kbyte of masked or OTP ROM. Using assembly language and this part, you can handle a range of low-end applications. Even better, you can prototype and do initial product builds with the OTP part, and when the design is stable, shift to lower-cost ROM parts. Clock rates run from 3.5 to 40 MHz. It executes a basic instruction cycle in 12 clock cycles. At 40 MHz, the CPU delivers 2- to 3-MIPS performance. You can also get a low-cost, pseudo ICE (in-circuit emulator) to debug your code. **Philips Semiconductors,** Sunnyvale, CA. (800) 447-1500. **Circle No. 528**

**PC-on-a-board suits embedded applications.** The SAT-V40 is a PC-compatible board for embedded applications. It includes 24 digital I/O lines, eight 12-bit ADC inputs, three serial ports, a printer port, three counter/timers, a watchdog timer, and a precision power-fail reset on a single board. An 8-MHz V40 μP controls the 4.5×7-in. board. Four 32-pin memory sockets support up to 2 Mbytes of memory. If you need more than the standard I/O options, you can add PC/104 modules to the board. You can also use the C-Thru-ROM C source-level debugger and the ROM-DOS embedded operating system. Prices for SAT-V40 start at $295. **WinSystems Inc,** Arlington, TX. (817) 274-7553. **Circle No. 529**

**High-voltage ICs displace magnetic components for electronic ballasts.** The IR2155 self-oscillating power MOSFET/insulated-gate bipolar-transistor (IGBT) gate driver is the first in a family of power ICs tailored to electronic ballasts for fluorescent lighting, partly because of its small size (8-pin DIP) and low cost ($1.96 (100) and $0.98 (50,000)). These power ICs can drive low- and high-side MOSFETs or IGBTs from logic-level, ground-referenced inputs. The IR2155 also suits high-frequency switch-mode power supplies and motor drives. The IC features an integrated high-side driver that replaces the discrete transformer drive circuits, an on-chip self-starting oscillator that eliminates additional control circuitry, and an on-chip shunt regulator that generates 15V from the high-voltage bus via a low-wattage dropping resistor. Because of the on-chip regulator, the IC can operate without a bias supply directly off the rectified line voltage. A companion driver, the IR2111 ($1.58 (1000)), is identical to the IR2155 except that it doesn't include the internal oscillator and regulator. You can use this IC with the IR2155 to implement a full-bridge 160W fluorescent ballast and other H-bridge circuits for larger power supplies. **International Rectifier,** El Segundo, CA. (800) 245-5549. **Circle No. 530**

**Disk-on-a-chip replaces BIOS EPROM and stores 16 Mbytes of data.** Portable and embedded computers can now include "disk" storage that takes up *no* space. DiskOnChip, a flash-memory module that replaces a computer's BIOS EPROM, stores not only the BIOS, but also as much as 16 Mbytes of programs or data. The multichip module includes an ASIC and a firmware-implemented flash-file system that together make the flash memory emulate a conventional disk drive. DiskOnChip's control ASIC and associated circuitry circumvent the BIOS socket's lack of a write-pin connection, thus allowing full read/write capability. Each DiskOnChip module contains at least one 1-Mbyte flash chip. The BIOS, flash-file system, and PCMCIA Socket Services software occupy about 0.1 Mbyte, leaving a minimum of 0.9 Mbyte of flash for use as solid-state disk storage. The modules operate at 5V

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and are available in 28-pin DIP and surface-mount versions. A 1-Mbyte module sells for $99 ($80 in quantities of 1000 or more). In high-capacity versions (4 Mbytes or more), the incremental cost is about $45 per megabyte. **Eurom Inc,** Fremont, CA. (510) 505-9083. **Circle No. 531**

**PCMCIA card holds removable hard-disk cartridge.** Removable disk storage goes an extra step in a new PCMCIA card. You can remove the card from your computer and can remove a plug-in 60- or 80-Mbyte disk cartridge from the card. You can even change cartridges without removing the card from your system. The SQ1080 is a Type III PCMCIA card with a 1.8-in. hard-disk drive. When you remove a cartridge from the card, all you remove is the disk platter and the cartridge housing. All of the disk drive's fragile components, including head assembly and spindle motor, remain in the card. SyQuest claims the cartridges can withstand shock forces of 2000g, compared with a typical 200g or less for a complete 1.8-in. drive. The combination of high shock tolerance and relatively low cartridge prices make the SQ1080 a strong candidate for portable data and program storage. The 80-Mbyte cartridge sells for $40 in OEM quantities, making incremental storage cost only about $0.50/megabyte. A fixed 1.8-in. drive of comparable capacity typically costs about $200 (OEM). SyQuest's OEM price for the SQ1080 and one removable cartridge is $300. **SyQuest Technology Inc,** Fremont, CA. (510) 226-4000. **Circle No. 532**

**$59 μC board is programmable in C.** The P-57 Mustang is the first in a series of small, low-cost boards that allow you to prototype in C. This first product is based on the PIC 16C57 μC from Microchip Technology. The board costs $59; in addition, you can buy the Mustang C development kit for $150, which includes a C compiler,


assembler, in-circuit simulator, and source-level debugger along with the 2×3-in. P-57 Mustang board, power supply, and RS-232C cable. The C compiler generates code for a virtual microcontroller (VMC). The CPU on the board emulates this generic VMC, making the C code portable to future versions of the Mustang board based on other μCs. The PIC 16C57 has 20 I/O lines, 2048×12-bit ROM, 72-byte RAM, and a real-time clock/counter. The board's 8-kbyte EEPROM is expandable to 64 kbytes. The $I^2C$ serial bus connects the EEPROM and the μC, providing an inexpensive memory interface that lets you easily expand memory capacity. A 1×2-in. prototyping area allows you to customize or expand the system. **P&E Microcomputer Systems Inc,** Woburn, MA. (617) 353-9206. **Circle No. 533**

**Op amp measures input current in $10^{-15}$A.** The LMC6001 A grade features a guaranteed input current of 25 fA when operating from a single 5V supply. This current is the equivalent of 156 electrons entering the input of an amplifier every millisecond. Grade B and C devices feature maximum input currents of 100 and 1000 fA, respectively. Other guaranteed characteristics include 350-μV offset voltages, 10-μV/°C drift, 850-μA maximum supply current, and a –40 to +80°C operating temperature range. Acknowledging the long-turn-on settling times common to other low-input-current amplifiers, the company also tests the A grade's input current at three intervals in the first minute of operation to guarantee quick settling. The device's input-referred noise is typically 22 $nV/\sqrt{Hz}$, and input-current noise is typically $1.3\times10^{-16}A/\sqrt{Hz}$. All grades are available in eight-pin DIPs with the above guaranteed performance. Pricing for the A, B and C grades is $8.50, $5.15, and $1.40 (1000), respectively. The A and B grades also come in metal cans for $12.50 and $8.50, respectively. **National Semiconductor,** Santa Clara, CA. (408) 721-6973. **Circle No. 534**

**68HC05 family member gets more ROM and RAM.** You don't need a big, expensive 8-bit microcontroller (μC) for many embedded tasks. But you do need low cost coupled with the right amount of on-chip memory and few peripherals. Targeting that need, Motorola has expanded the K series μCs, the low end of the base 68HC05. The 68HC05K3 delivers an 8-bit μC with 64 bytes of RAM, 920 bytes of ROM, and 32 bytes of byte-erasable EEPROM. The K3 expands on-chip memory from the earlier K0 and K1, which have 32 bytes of RAM, 504 bytes of ROM, and 64 bits of user EPROM (K1). The larger memory gives you more room to execute code and hold intermediate values, as well as work with a larger software stack. Like the K0, the K3 is also available in a 1.8V, low-power versions for power-restricted applications. $2.26 (50,000) for 1.8V version. **Motorola Inc,** Austin, TX. (512) 891-2000. **Circle No. 535**

**68060 μP runs three times faster than 68040.** By employing techniques developed for RISC processors, the 2.5-million transistor 68060 μP executes the 68040 instruction set with three times the performance at twice the clock rate of the 68040. Features to achieve this boost include a deep execution pipeline, dual-issue superscalar execution units, an internal Harvard architecture with separate 8-kbyte instruction and data caches, a branch cache, and a demand-paging memory-management unit (MMU). Including the on-chip floating-point unit (FPU), the 68060 executes 250M operations/sec at 50 MHz. The 68060 family includes three μPs: the 68060, the 68LC060, and the 68EC060. The 68LC060 omits the on-chip FPU, and the 68EC060 omits the FPU and the MMU. Two four-stage RISC engines execute the fixed-format instructions emitted

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| SPECfp92 | 134.8 | 183.9 | 183.9 |
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| I/O Slots | 2 PCI/ISA 1 ISA | 2 PCI/ISA 1 ISA | 2 PCI 3 ISA, 1PCI/ISA |
| Max I/O | 132MB/sec | 132MB/sec | 132MB/sec |
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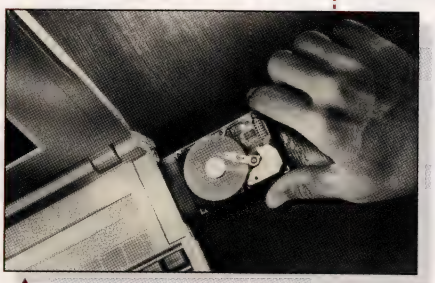
by the instruction converter. The 68060 can simultaneously execute two integer instructions or one integer and one floating-point instruction. The 68060 is fully compatible with the 68040's user mode. However, there are differences in the supervisory mode. Most important, the 68060 has a smaller stack frame than the 68040, so you must rewrite supervisory code that makes direct accesses to state information in the stack frame. In addition, the 68060 employs a bus that's compatible with the 68040. 68060, $263; 68LC060, $169; 68EC060, $150 (10,000). **Motorola Inc**, Austin, TX. (512) 891-2917.

**Circle No. 536**

**GPS receiver fits in 3U VME card.** The DGPS is a low-power 3U VME module that contains a complete GPS receiver. The receiver can track six of eight available satellites and automatically selects among the eight to obtain the most accurate position and velocity data. Connection to the receiver data is made through a serial port. The module also provides a 1-pulse/sec timing signal accurate to 1 msec and a universal time code. The module comes with a microstrip antenna. $1092 (OEM qty). **Dynatem**, Mission Viejo, CA. (714) 855-3235. **Circle No. 537**

**PCMCIA disk drive stores 128 Mbytes.** A 128-Mbyte, 1.8-in. hard-disk drive from MiniStor is the highest capacity PCMCIA drive currently shipping. The two-platter drive uses glass media for increased capacity and shock-sensor technology to protect data from errant write heads during an impact. Shock tolerance is 200g. Mounted on a card that fits into a Type III PCMCIA slot, the drive is available with a PCMCIA or an IDE interface. Average seek time is 16 msec, average latency is 6.67 msec, and data-transfer rates range from 11 to 22 Mbps. $699.



Also from MiniStor for use with any PCMCIA card is a unit that adds a PCMCIA slot to a drive bay of any PC/AT-type system. Suggested retail price for the DockIt Socket is $249. **MiniStor Peripherals Corp**, San Jose, CA. (408) 943-0165. **Circle No. 538**

**Enhanced system memory boosts board performance.** By employing a memory architecture that always provides peak performance, two additions to the MVME197 board family are able to achieve more than 150 MIPS per processor. The boards come in one- and two-processor versions, and a four-processor version planned for early 1994. The architecture of the MVME197SP and MVME197DP boards begins with 128 Mbytes' worth of error-checking and -correcting DRAM coupled to an 88110 processor. Mezzanine expansion boards can build the main memory size to 640 Mbytes. The memory's design supports 3-1-1-1 burst transfers. Cache structures augment the main memory design on both boards. Each processor features 16 kbytes of on-chip cache. In addition, the boards have up to 256 kbytes of secondary cache for each processor. The combined effect of these memory structures is a MIPS rating of 153 for each processor. To develop software for real-time applications, the boards offer compatibility with VMEexec, a proprietary development-tool suite. The boards also feature SCSI-2 and Ethernet I/O ports and software compatibility with the earlier MVME187 board family. Software the boards can run includes Unix System V/88 release 4.1, PSOS, and VxWorks. The SP single-processor model sells for $32,995; the dual-processor board costs $44,995. **Motorola Computer Group**, Tempe, AZ. (602) 438-3000.

**Circle No. 539**

**SCSI adapter for PCI bus processes 2000 I/O requests/sec.** QLogic's QLA1000-PI SCSI host-adapter board for the PCI bus processes 2000 I/O requests/sec while queuing 1600 requests/sec. It provides burst data transfers at 132 Mbytes/sec and sustained transfers of 20 Mbytes/sec. The board achieves its performance via the company's ISP1020 SCSI coprocessor that has dual on-chip processors. One processor controls the SCSI-bus protocol; the other, a 16-bit RISC processor, handles data flow and related commands. The board is ASPI- and CorelSCSI-compatible and is available with drivers for DOS, Windows, Windows NT, NetWare, SCO Unix, and OS/2. $289 (1); <$200 (OEM). **QLogic Corp**, Costa Mesa, CA. (714) 438-2200.

**Circle No. 540**

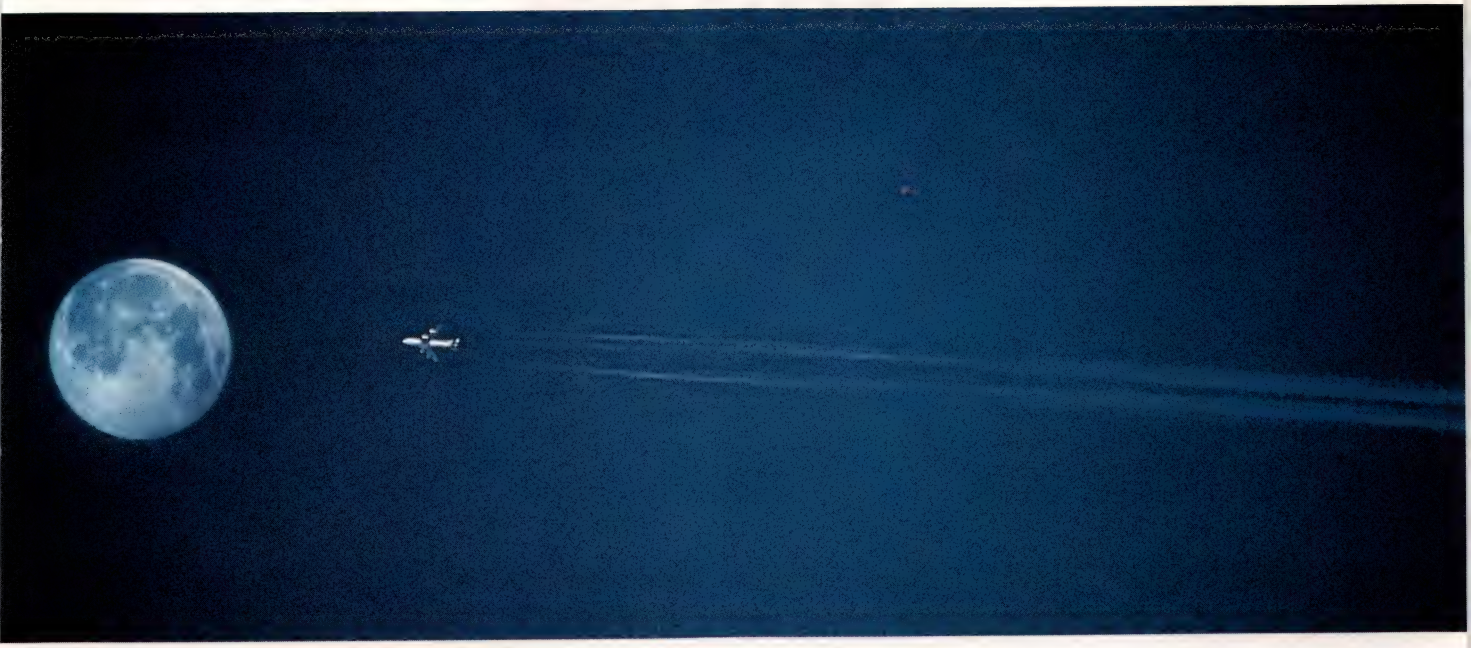
**IC pair provides FM LED data link.** The CSA1781N is an FM modulator that puts digital data on an LED beam using FSK modulation. A companion chip, the CXA1111P/N is an AM/FM-radio IC that decodes the LED-transmitted data. The pair operates over a 2.6 to 6V supply range and can create an IR data link that handles 60 kbps. Samples are available; the CXA1781 costs $12, and the CXA1111 costs $5. Production price will be $10.50 and $1.60 (1000), respectively. **Sony Component Products Co**, Cypress, CA. (800) 288-7669. **Circle No. 541**

**Free design estimator compares the advantages of EPLDs.** The Logic Professor compares Xilinx EPLDs as a replacement for TTL and other PLDs. You enter the design specifications, and the software estimates the number and type of EPLDs you need to perform the task. **Xilinx Inc**, San Jose, CA. (800) 231-3386.

**Circle No. 542**

**Not just for the military anymore.** Until recently, the high prices ($3000 to $15,000) of night-vision devices kept them out of the range of most users. Now Moonlight Products carries a line of these devices, including scopes, binoculars, and goggles, with prices ranging from $459 for the palm-sized Moonwalker scope to $1999 for the MPN 50K-I night-vision goggles. Although the company originally targeted the products at border-patrol and law-enforcement agents, people are buying the devices for recreation,

# Technical Support...



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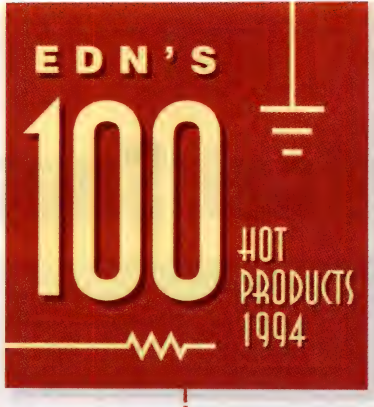



such as boating, observing wildlife, and photography. The latest addition to the line, the Moonlight NV-100 ($749), is an advanced electro-optical spotting scope featuring 10,000-times light-amplification capabilities and 4.3-times image magnification. The extra image magnification of the optics allows you to see longer distances than most night-vision devices allow, according to the company. **Moonlight Products**, San Diego, CA. (619) 625-0300. **Circle No. 543**

**Document-management system runs under Windows.** The AutoEDMS document-management system for Windows lets you find, store, manage, retrieve, view, and print virtually every type of drawing, document, and image. The software provides document tracking to meet ISO 9000 requirements. AutoEDMS for Windows starts at $895. **ACS Telecom**, Lomita, CA. (310) 325-3055. **Circle No. 544**

**EPLD-design software costs $89.95.** XEPLD version 4.1 is a design tool for Xilinx XC7000 family of erasable programmable logic devices (EPLDs). The software interfaces to logic compilers, such as ABEL, CUPL, and Palasm. **Xilinx Inc**, San Jose, CA. (408) 559-7778. **Circle No. 545**

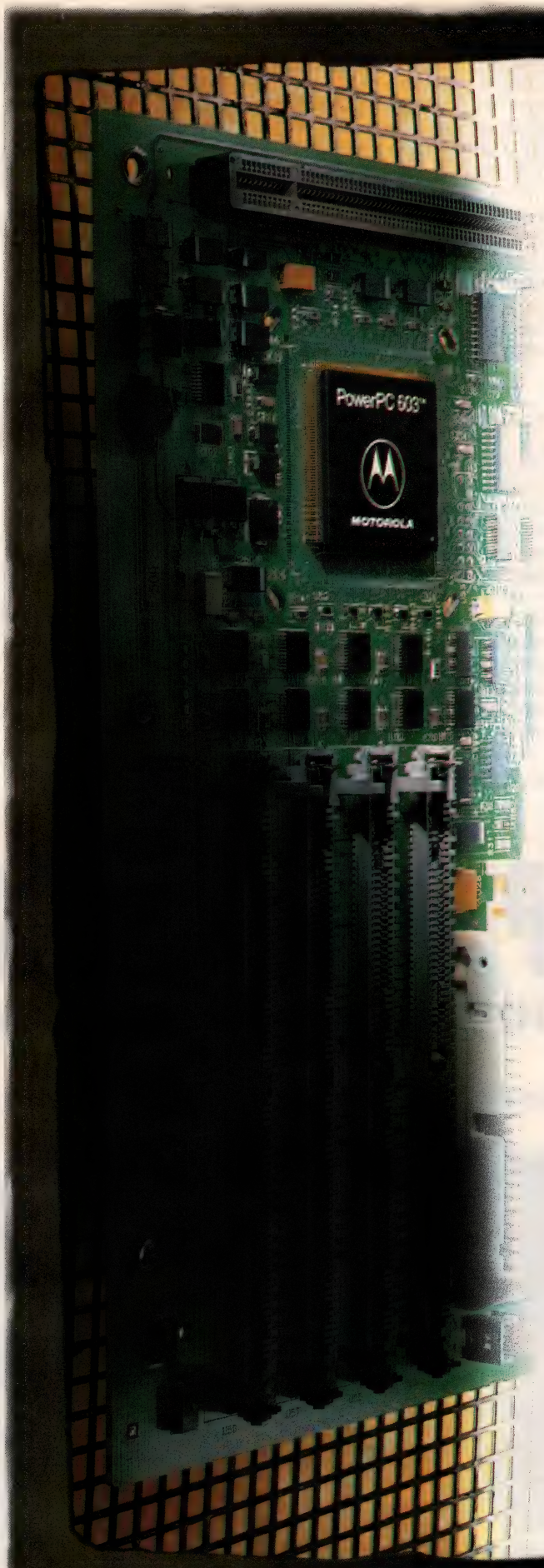
**The fuzzification of DSP.** One reason to use fuzzy logic on a DSP chip is flexibility. You may already be using a DSP chip in your application. But you may want to implement some of the design using fuzzy logic. You can always create the fuzzy-logic code by hand where you need it. Now you can use fuzzy-logic development tools. Inform Software Corp's fuzzyTECH MCU320 tools generate optimized assembly-language code for Texas Instruments' TMS320C2X and TMS320C5X fixed-point DSP chips. They also generate C code for use on the TMS 320C3X and TMS320C4X floating-point DSP chips. The fuzzyTECH MCU-320 Edition ($1890) is a software-development environment that includes graphical design editors, simulators, and application-code generators. The fuzzyTECH MCU-320 Explorer ($199) is an evaluation version that includes all the same tools but limits the design to two inputs and one output. It also includes an animated simulation to get you started. **Texas Instruments Inc**, Houston, TX. (800) 477- 8924, ext 4500. **Circle No. 546**

**Z80 extended to 16 bits, 32-bit addressing.** The Z380 16-bit µP supports clock rates up to 40 MHz. Unlike the Z80's 4-bit data paths, the Z380 has full 32-bit data paths for 32-bit address and data calculations. It performs 8-, 16-, and 32-bit operations. The Z380 also extends the Z80's dual-register set to two register groups, each with four sets of registers. You can use the Z380 register sets as register banks for fast context switching. The Z380 takes two 40-MHz clocks to execute a basic instruction (100 nsec). Most instructions execute in three clock cycles. The Z380's hardware is semipipelined: It starts the next instruction fetch while finishing execution of the current instruction. The Z380 is code-compatible with the Z80 and Z180 µPs. $10 (100,000). **Zilog Inc**, Campbell, CA. (408) 370-8056. **Circle No. 547**

**Radar technology licensed for automotive-safety applications.** Drivers may soon receive some high-tech help in avoiding collisions, thanks to radar-based sensors. The Department of Energy's Lawrence Livermore National Laboratory developed the sensors using off-the-shelf components and licensed the technology to Amerigon Inc (Burbank, CA). The sensors include a receiver that detects echoes of rapid, wideband radar pulses (about 1 million/sec) reflected from objects at distances from 0 to 200 ft. A computer chip generates short electrical pulses (from 50 trillionths of a second to less than 1 billionth of a second), which the sensors then send out, receiving back radar echoes. The devices accept echoes only from objects within set distances, adjust to the objects within that environment, and detect any motion within those areas. Amerigon anticipates using the technology to create onboard devices to signal for vehicles in a driver's blind spot and to act as backup warning systems and parking aids. **Lawrence Livermore National Library**, Livermore, CA. (510) 422-1100. **Circle No. 548**

**Seven-chip set builds digital TV camera.** A seven-chip set of ICs from Hitachi lets you build small, CCD-based, digital-TV cameras. The chip set comprises the H8/337 µC, the HA118144 correlated double-sampling/automatic gain-control (CDS/AGC) IC, the HD49306 9-bit A/D converter, the HD49801 video DSP, the HD49803 timing generator, the HD49307 three-channel, 8-bit D/A converter, and the HD49802 electronic-zoom IC. Because of the digital-camera architecture, this chip set reduces the number of camera adjustments to five from the typical 10. In addition, the DSP technology suppresses the false signals associated with CCD image sensors. The digital-camera chip set accommodates CCDs with effective horizontal resolutions to 768 pixels. The CDS/AGC IC amplifies and compensates the CCD's output signal and feeds the processed signal to the DSP. All image-quality manipulation, including color clipping, gamma compensation, and color gain, occur within the DSP. For analog-output cameras, you can feed the digital output of the DSP directly to the chip set's three-channel D/A converter. A member of the company's H8 µC family, the H8/337, controls all digital-camera functions. This µC incorporates 32-kbyte RAM. The chip set is available in several packaged versions. A prototype chip set, model HMM49111, costs $95. The HMM49101 basic production chip set costs $65 (10,000), and the HMM49104 basic production chip set with electronic zoom costs $85 (10,000). **Hitachi America Ltd**, Brisbane, CA. (415) 589-8300. **Circle No. 549**

**Tiny, PC-compatible computer has graphics display.** The PC-compatible FPWX includes an LCD graphics display in a thin, flat package measuring 2.6×4.5×1 in. The display has a 128×64-pixel monochrome, graphic, back-lit or reflective LCD.




# WHAT MAKES THE NEW PowerPC BOARDS FROM MOTOROLA SO FAST?

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The CPU is a 9.2-MHz processor with 128 or 512 kbytes of system RAM, 128 or 256 kbytes of BIOS EPROM, and a socket for one 128- to 512-kbyte disk-emulator EPROM or flash EEPROM. A 64-pin PC-104 bus pinout-compatible header provides expansion. Adapters are available for ISA bus and PC-104 cards. The basic system with 128-kbyte RAM costs $249 (100). **Mesa Electronics,** Emeryville, CA. (510) 547-0837. **Circle No. 550**

**Software-based sound synthesizer costs less than $5.** Integrated Circuit Systems (ICS) has introduced the WaveFront VS, a general-MIDI wavetable synthesizer. The software runs under Windows and works on 486- and Pentium-based PCs that have audio codecs. It makes high-quality wavetable synthesis widely available at $4 (10,000). The software improves the sound quality over FM-music synthesis, the current technology for low-end sound cards, in Windows applications. ICS licensed the technology from its developer, Intel Architecture Labs. Under terms of the agreement, the two companies will market the technology jointly. **Integrated Circuit Systems Inc,** Valley Forge, PA. (610) 630-5300. **Circle No. 551**

**Data compression as fast as 40 Mbytes/sec.** The ALDC1-20S and -40S adaptive lossless data-compression chips allow 20- and 40-Mbyte/sec processing. The chips provide data-compression ratios greater than 2 to 1 in real time. The devices support multiprotocol DMA interfaces, industry-standard µP interfaces, eight/16 selectable data buses with selective parity checking, and 16-byte FIFO buffering and bypass mode. Both devices employ a 5V, 0.8-µm CMOS process. The ALDC1-20S sells for $38.30; the ADLC1-40S sells for $70.20 (10,000). **IBM Microelectronics,** Hopewell Junction, NY. (914) 892-5389. **Circle No. 552**

**Prototype real-time graphical human-machine interfaces.** VAPS 3.1 provides a set of tools to help you build real-time graphical human-machine interfaces. In addition to helping you create a prototype, the VAPS C code generator translates the graphical prototypes, including animation properties, interactive behavior, and connections into executable C code. You can integrate the generated C code with real-time kernels. VAPS runs on workstations, and prices start at $16,500. The company plans to introduce a version for Windows. **Virtual Prototypes Inc,** Montreal, PQ, Canada. (514) 341-3874. **Circle No. 553**

**Single-chip function generator operates at 20 MHz.** The MAX038 function generator produces sine, square, sawtooth, and pulse waveforms at up to 20 MHz using only a few external components. Typical sinewave distortion is <1%. A programmed current (2 to 700 µA) and an external capacitor control the oscillation frequency. An external control voltage produces pulse-width-modulation or sawtooth waveforms by varying the duty cycle between 10 and 90%. Another control voltage modulates the programmed frequency by ±70%. The

EDN'S 100 HOT PRODUCTS 1994

output buffer has a 0.1Ω output impedance and delivers ±20 mA to a load. The MAX038 comes in 20-pin DIP or wide-SO package. From $9.50 (1000). **Maxim Integrated Products**, Sunnyvale, CA. (408) 737-7600, ext 6087.

**Circle No.554**

**Thermoelectric coolers offer larger temperature drops and lower power consumption.** The K series thermoelectric coolers come in one-, two-, three-, or four-stage versions. Single-stage versions can develop a 70°K differential while multistage coolers can drop 120°K or more. The multistage coolers use different materials for their various stages. Built-in thermistors are also available. The coolers measure 40×40 mm; heights range from 2.6 to 32.2 mm. Single-stage cooler, $5; four-stage, $35. **Atramet Inc**, Farmingdale, NY. (516) 694-9000.

**Circle No. 555**

**FPGA hits 100-MHz counters.** The pASIC38x FPGAs combine a proprietary antifuse technology with a single flip-flop/multiple-output core logic element and X-Y-matrix chip routing. Cypress claims FPGA clock rates up to 100 MHz for loadable counters and 85 MHz for chip-to-chip operations. Built on a 0.65-µm CMOS process, the FPGA architecture relies on an amorphous-silicon antifuse. The antifuse is blown to make a connection and has a resistance of 50V with less than 1-fF capacitance. The architecture provides 1000 to 4000 usable gates. Chip I/Os range from 40 to 122 pins. The architecture provides eight high-drive input cells for high-fan-out I/O inputs and two high-drive clock cells for clocking. I/O cells do not have sequential elements. Each I/O is bidirectional and is driven internally by an enabled inverter fed by a two-input OR gate (one input negated). Cypress supplies a VHDL-based tool set, Warp3, for development. Warp3 supports the pASIC380 family as well as Cypress PLDs. The kit provides VHDL top-level design and simulation, including device targeting and device-specific timing simulation. **Cypress Semiconductor**, San Jose, CA. (408) 943-2600.

**Circle No. 556**

**IDE cache controller boosts disk-I/O rates.** The BusLogic KT-410A, 910A, and 510A IDE cache controllers for the VL, PCI, and ISA buses, respectively, greatly increase the throughput of data between disk drives and a system processor. The PCI- and VL-bus versions transfer data at 5 Mbytes/sec on the disk side and 20 Mbytes/sec on the system side. The ISA version has a transfer rate of 5 Mbytes/sec on both sides. Each controller connects a system to four IDE drives, each storing as much as 4 Gbytes, and two floppy-disk drives. You can

configure the controllers to provide disk mirroring or linking. The controllers require the addition of DRAM cache memory in 256-kbyte, 1-Mbyte, or 4-Mbyte SIMMs. You can mix and match different-capacity SIMMs for a total of 512 kbytes to 16 Mbytes of cache. The VL, PCI, and ISA versions cost $175, $255, and $105, respectively. **BusLogic Inc**, Santa Clara, CA. (408) 492-9090.

**Circle No. 557**

**FPGA environment simplifies the design process.** Taking an FPGA design from concept to silicon typically requires the use of many tools. ViewFPGA simplifies this task by controlling and automating the process. The software provides process and data management, integration to system-level design, and links to FPGA-vendor layout tools. By tightly integrating more than 50 tools and utilities, the software reduces the learning curve for executing FPGA designs. Because ViewFPGA keeps you following the correct design methodology, you no longer have to know the detailed design processes of—and differences between—each family of FPGAs. To create designs, use any combination of schematics, ABEL, JEDEC, and VHDL. Coupling hardware description languages (HDLs) using VHDL or ABEL with logic synthesis lets you create and simulate a design before selecting a target FPGA device. Cross-probing among any of the design-entry methods and simulations simplifies design debugging. If you already use Viewlogic's Unix-based Powerview or Windows-based Workview Plus family of design tools, you can add ViewFPGA for $8200 or $5750, respectively. ViewFPGA is part of Programmable Architect, which costs $25,000 for Unix-based systems and $21,000 on Windows-based systems. ViewArchitect also provides design entry, simulation, and synthesis capabilities. Programmable Architect, in turn, is part of Programmable Expert, which costs $30,000 for Unix-based systems and $25,000 for Windows-based systems. Programmable Expert also includes Programmable Architect plus place-and-route tools for Actel, Altera, or Xilinx. **Viewlogic Systems**, Marlboro, MA. (508) 480-0881.

**Circle No. 558**

**Zeropower SRAM provides battery-backed memory for SMT boards.** The two-piece Zeropower and Timekeeper battery-backed SRAMs allow you to send the IC portion of the assembly through SMT manufacturing equipment without melting the battery. The M48Z18-100MH1 Zeropower RAM is an 8-kbyte, 100-nsec SRAM. A companion snap-on battery pack called the M4Z28-BR00SH1 preserves the SRAM's contents for more than 10 years without external power. The M48T18-100MH1 Timekeeper RAM adds a real-time clock to the 8-kbyte SRAM. A combination battery/crystal Snaphat for the Timekeeper RAM is called the M4T28-BR12SH1. The real-time clock's registers occupy the top 8 bytes of the RAM's 8-kbyte address space. Uncorrected, the clock crystal in the M4T28-BR12SH1 is accurate to approximately one minute per month. Using software-calibration routines and an internal Timekeeper calibration register, you can improve that accuracy to

better than five sec/month. Both the Zeropower and Timekeeper RAMs incorporate circuitry that monitors the external system power. This circuitry switches the RAM's power source to the on-chip battery and disables system access to the protected RAM when external power fails. This is the circuitry you would have to design if you were developing your own battery-backed SRAM. Both the Zeropower and Timekeeper SMT RAMs come in conventional-size 28-lead SOICs. M48Z18-100MH1 Zeropower RAM, $6.25; M4Z28-BR00SH1 battery module, $1.75; M48T18-100MH1 Timekeeper RAM, $10; M4T28-BR12SH1 battery/crystal module, $2 (10,000). **SGS-Thomson Microelectronics**, Phoenix, AZ. (602) 867-6100.

**Circle No. 559**

**Smart ATM switch self-routes cells.** Designed to handle data in packets, the T7650 switch provides a 2×2 switching node that meets the needs of asynchronous-transfer-mode (ATM) switching applications. The device is self-routing and crosspoint-buffered, allowing it to automatically route and pass ATM cells without collision. The switch's function is to accept synchronously clocked data packets in 8-bit (with parity) parallel form from an input port and pass the data to the appropriate output port. The data packets the device passes can be 10 to 80 bytes long and must contain header information that describes the packet's length. Once the device establishes a data path, it counts the bytes passing through to ensure that the entire packet has moved before changing its configuration. The switch routes the high-priority data first. If the data has a clear path through the switch, the data passes through without buffering, achieving a latency of 11 clock cycles. If the switch is already in use, however, it stores incoming data packets in one of 16 on-chip 512-byte FIFO buffers—one FIFO for each of the four priority levels along each of the four possible paths through the switch. The T7650 offers a TTL-compatible interface. $23.45 (10,000). **AT&T Microelectronics**, Allentown, PA. (800) 372-2447.

**Circle No. 560**

**Digital audio chip provides CD-quality sound.** The EMU8000 digital audio chip for add-in and motherboards is part of an audio system comprising the EM81000 sound-file library and EMU8200 control software. The sound library resides in external ROM and DRAM. The system also provides MIDI compatibility, user-definable sampled sound libraries, 32-voice polyphony, digital sample-rate conversion, and audio pitch transposition. $35 for DSP chip and ROM. **E-MU Systems Inc**, Scotts Valley, CA (408) 438-1921.

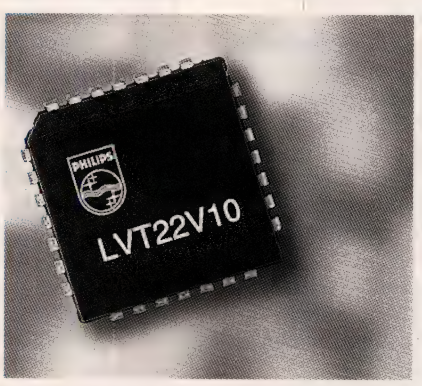
**Circle No. 561**

Philips Semiconductors **Update**

# Fastest 3.3 V PLD provides high performance with low output noise

The new LVT22V10-7 3.3 V PLD is a 7.5 ns device that gives designers the speed required to keep up with the increasing performance of leading 3.3 V microprocessors and memory devices.

The LVT22V10-7 provides speed as well as key features that are essential for high-performance systems including low noise, high drive, 3.3 and 5 V compatible inputs and outputs, live insertion and graceful power-up for the design engineer




*The LVT22V10-7 is the industry's fastest 3.3 V PLD, the latest in a series of high-performance PLDs from Philips.*

The device has virtually no ground bounce with only 0.8 V $V_{olp}$ under worst-case conditions (one output held low and nine outputs switching, each with a 50 pF load at 3.6 V). With system clock rates at 90 MHz and above, noise becomes a critical design consideration and the LVT22V10-7 decreases output noise by 50% compared with CMOS PLDs.

The LVT22V10-7 is the fastest in a series of high-performance 3.3 V programmable devices from Philips.

It joins the LVT22V10-10 and LVT22V10-15, which are 10 ns and 15 ns devices respectively.

**Call 1-800-447-1500 Ext 1162**
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**All Philips Semiconductors plants worldwide are ISO 9000 certified**

# First fully-programmable BiCMOS DRAM controller for high-speed dual-port memory systems

Combining the efficiency of a standard dual-port DRAM controller with the flexibility of an application-specific device, the new 74ABT4764 features an 80 MHz on-chip PLD sequencer that can be programmed to control high-performance memory systems. In addition to operating with any type of DRAM, the 74ABT4764 has the ability to interface directly to CISC processors, RISC processors and DMA channels without the need for glue logic, and to arbitrate memory requests from any two of these devices and the memory's refresh logic.

Equipped with 16 CAS (column address strobe) outputs, four RAS (row address strobe) outputs and an on-chip multiplexer for 11-bit memory addresses, the 74ABT4764 directly addresses up to 4 Mbytes of memory. This can be made up from DRAMs with capacities up to 16 Mbit (4M x 4), and with the addition of a few inexpensive logic chips the device can also address 64 Mbit DRAMs. Memory access modes include page, fast page, interleaved page, nibble and static column modes, with datapaths up to 8 bytes wide.


*The 74ABT4764 fully-programmable BiCMOS DRAM controller offers exceptional flexibility.*

The key to the 74ABT4764's exceptional flexibility is the on-chip PLD sequencer that controls the row/column address counters and multiplexer, the loop counter and an active page comparator that detects whether the current row address is within an active memory page. The counter overflow outputs and the hit/miss output of the active page comparator all feed back to the sequencer inputs.

The 74ABT4764 is manufactured in Philips' QUBiC BiCMOS process.

**Call 1-800-447-1500 Ext 1161**
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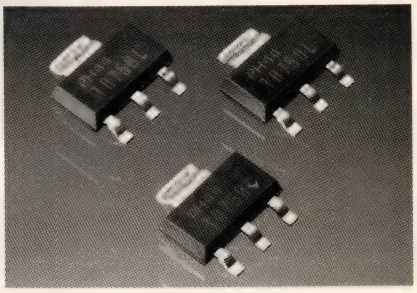
**Philips Semiconductors**

## SOT223-packaged power MOSFET has full on-chip protection

With the introduction of the BUK107 logic-level TOPFET, Philips Semiconductors is the first company to offer a temperature and overload protected 0.5 A low-side driver in a SOT223 surface-mount package. The BUK107 is designed primarily for lamp, solenoid and small motor switching in automotive applications such as engine management and driver information systems, but its built-in protection against short-circuit, over-temperature and over-voltage conditions also makes it suitable for a wide range of industrial applications where high reliability is required.

The transistor is available in two versions, either with a logic level control input that can be driven directly from a microcontroller port, or with a clamped input that can be used with a pull-up resistor drive circuit.



*The BUK107 power MOSFET is the first fully-protected low-side driver to be offered in a true SMD package.*

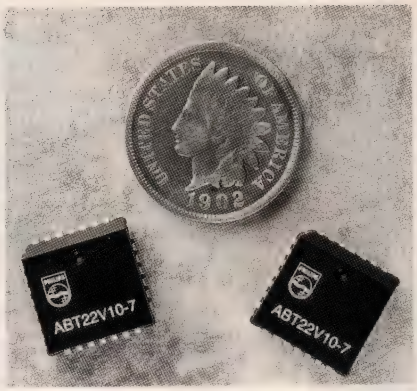
The BUK107 is a vertical DMOS power FET with an overload protection circuit that limits the drain current to typically 1 A, and an over-temperature protection circuit which senses the junction temperature to prevent thermal damage. In addition, integral over-voltage clamping diodes coupled with controlled turn-off of the FET limit the drain voltage to 50 V, allowing the BUK107 to be used for inductive load switching. No external protection components are required; all the active on-chip protection circuits are powered directly from the control input, so the BUK107 has an off-state current consumption of typically 1 µA at 50 V. The device is housed in a standard SOT223 package with all pins protected against electrostatic discharges.

**Call 1-800-447-1500 Ext 5018**
**Europe: circle no. 42**

## High-speed 22V10 PLD reduces circuit noise by 50%

In applications where low noise, high drive capability and metastable immunity are critical, the ABT22V10-7 out-performs all other 22V10 devices on the market, while reducing circuit noise by as much as 50%. Fabricated in Philips' QUBiC BiCMOS process and using their unique Advanced Feedthrough Cancellation technology, the device offers 7.5 ns maximum propagation delays, less than 0.8 V ground bounce under worst-case switching conditions and complete freedom from output glitching even when input set-up and hold times are violated.

The ABT22V10-7 is designed for use in high-speed applications such as high-speed telecommunications switches, satellite communications equipment, networks and workstations. Its 48 mA drive capability allows the outputs to be directly connected to a backplane bus, thus saving the cost, power consumption and additional propagation delays associated with a separate bus driver




*The ABT22V10-7 ultra-quiet PLD is available in 24-pin DIP and 28-pin PLCC packages. Military versions speced at 8.5 and 10 ns are also offered.*

chip. On-chip slew rate control for the high drive capability outputs ensures that bus reflections are kept to a minimum, further reducing overall system noise levels.

The ABT22V10-7 is the first of a comprehensive range of high-performance, ultra-quiet BiCMOS PLDs from Philips Semiconductors.

**Call 1-800-447-1500 Ext 1159**
**Europe: circle no. 43**

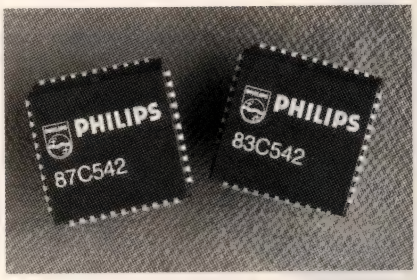
## New 8042-compatible ACCESS.bus microcontroller

Philips Semiconductors has introduced the first in a family of ACCESS.bus microcontrollers that will replace the 8042 controller which is used in most PC motherboards for keyboard and mouse control.

The 8XC542 combines the 80C51 microcontroller core with ISA bus interface and a controller for the ACCESS.bus port. The new device increases program memory to 4 kbytes and RAM to 256 bytes. The enhanced ISA bus interface provides multiple registers for supporting 32-bit data; programmable decoding for ten address lines saves external logic and allows the user to locate the controller in convenient memory space.

The 8XC542 microcontroller supports the current technology of the 8042 and increases its performance, while supporting ACCESS.bus, the new open industry 'plug-and-play' peripheral connectivity standard. It provides a simple and inexpensive way to daisychain I/O devices including mice, keyboards, trackballs and monitors to a single computer port.

With the recent approval by the Video Electronic Standards Association (VESA) of




*The 8XC542 combines the performance of the 80C51 microcontroller architecture with ISA bus interface and an ACCESS.bus port.*

the display channel standard called Display Data Channel (DDC), the 8XC542 becomes an integral part in the communications between the PC motherboard and the monitor display controller. With DDC the user has the ability to change the color and the screen sizing of the monitor directly from the PC.

ACCESS.bus microcode and PC software for the 8XC542 are available from Computer Access Technology Corporation (CATC).

**Call 1-800-447-1500 Ext 1160**
**Europe: circle no. 44**

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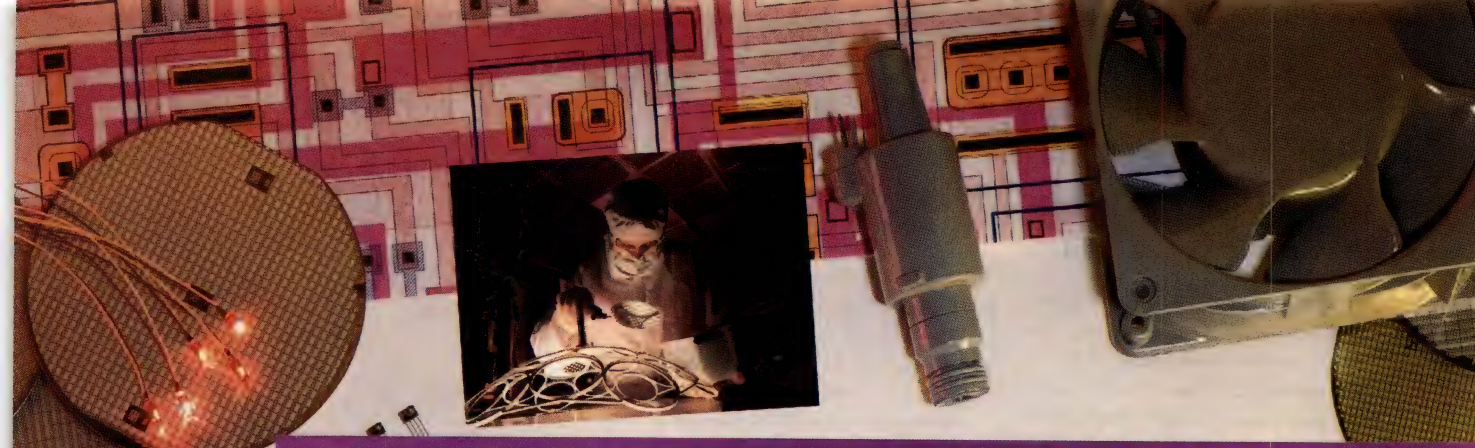
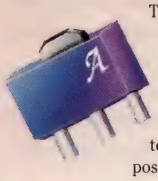


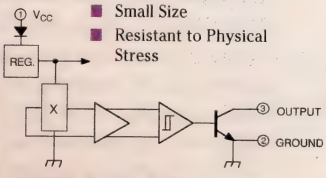
# CURRENT SHOWCASE

## Hall-Effect Latches For High-Temperature Operation — 3185



The 3185 Hall-Effect Latch is an extremely temperature-stable and stress-resistant sensor especially suited for operation over extended temperature ranges to +150°C. Superior high-temperature performance is made possible through a novel Schmitt trigger circuit that maintains operate and release point symmetry by compensating for temperature changes in the Hall element. Additionally, internal compensation provides magnetic switch points that become more sensitive with temperature, hence offsetting the usual degradation of the magnetic field with temperature. The symmetry capability makes these devices ideal for use in pulse-counting applications where duty cycle is an important parameter.

- Symmetrical Switch Points
- Superior Temperature Stability
- Operation From Unregulated Supply
- Open-Collector 25 mA Output
- Reverse Battery Protection
- Activate With Small, Commercially Available Permanent Magnets
- Solid-State Reliability ... No Moving Parts
- Small Size
- Resistant to Physical Stress

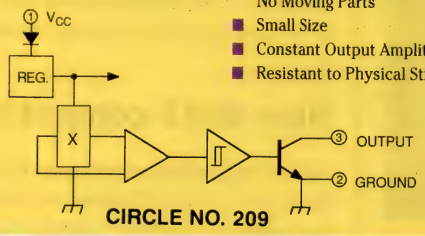



**CIRCLE NO. 208**

## Ultra-Sensitive Bipolar Hall-Effect Switches — 3132

These Hall-Effect switches are designed for magnetic actuation using a bipolar magnetic field, i.e., a north-south alternating field. They combine extreme magnetic sensitivity with excellent stability over varying temperature and supply voltage. The high sensitivity permits their use with multi-pole ring magnets over relatively large distances.

- 4.5 V to 24 V Operation
- Reverse Battery Protection
- Superior Temperature Stability
- Superior Supply Voltage Stability
- Activate with Multi-Pole Ring Magnets
- Solid-State Reliability ... No Moving Parts
- Small Size
- Constant Output Amplitude
- Resistant to Physical Stress

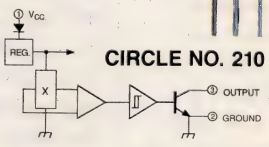



**CIRCLE NO. 209**

## Hall-Effect Switches For High-Temperature Operation — 3121

These Hall-Effect switches are monolithic integrated circuits with tighter magnetic specifications and switch points, designed to operate continuously over extended temperatures to +150°C, and are more stable with both temperature and supply voltage changes. The unipolar switching characteristic makes these devices ideal for use with a simple bar or rod magnet.

- Superior Temperature Stability for Automotive or Industrial Applications
- 4.5 V to 24 V Operation ... needs only an unregulated supply
- Open-Collector 25 mA Output ... Compatible with Digital Logic
- Reverse Battery Protection
- Activate with Small, Commercially Available Permanent Magnets
- Solid-State Reliability ... no moving parts
- Small Size
- Resistant to Physical Stress

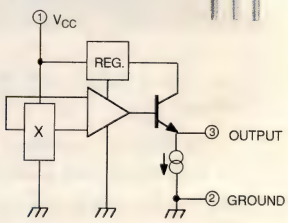



**CIRCLE NO. 210**

## Ratiometric, Linear Hall-Effect Sensors — 3503

The 3503 Hall-Effect sensor accurately tracks extremely small changes in magnetic flux density—changes generally too small to operate Hall-Effect switches.

As motion detectors, gear tooth sensors, and proximity detectors, they are magnetically driven mirrors of mechanical events. As sensitive monitors of electromagnets, they can effectively measure a system's performance with negligible system loading while providing isolation from contaminated and electrically noisy environments.

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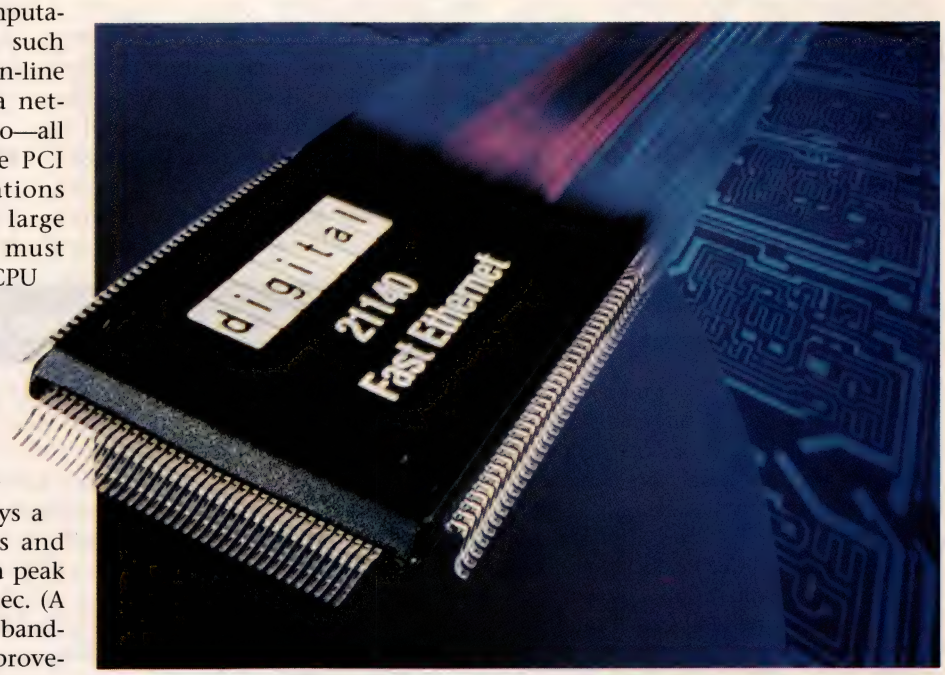
# PCI BUS *SPEEDS* PERIPHERAL COMMUNICATIONS

JOHN GALLANT, TECHNICAL EDITOR

**HIGH-SPEED PERIPHERALS MUST GET ON A HIGH-SPEED HIGHWAY TO MAKE USE OF ALL THEIR CAPABILITIES. THE PCI BUS IS ONE SUCH HIGHWAY, BUT ON-RAMPS IN THE FORM OF OFF-THE-SHELF, GENERAL-PURPOSE PCI I/O CONTROLLER CHIPS ARE FEW AND FAR BETWEEN.**

The Peripheral Component Interconnect (PCI) bus can bypass the I/O bottlenecks of traditional system buses and can provide a short cut for system CPUs to communicate with peripherals. Fast communications are essential in computation-intensive applications, such as sophisticated graphics, on-line data processing, local-area networking and real-time video—all major beneficiaries of the PCI local bus. These applications require the processing of large amounts of data, which must move quickly between a CPU and a peripheral.

To move data quickly, the high-performance, local PCI bus runs at a maximum clock speed of 33 MHz and accommodates three expansion-board connectors. It employs a 32-bit multiplexed address and data path, which provides a peak bandwidth of 132 Mbytes/sec. (A 64-bit path is optional.) The bandwidth is a substantial improvement over the 5-Mbyte/sec transfer rate of the standard ISA bus.




**Digital Equipment Corp's 21140 Fast Ethernet I/O controller provides 10- and 100-Mbps ports to conform to 10BaseT and 100BaseT Ethernet networks.**

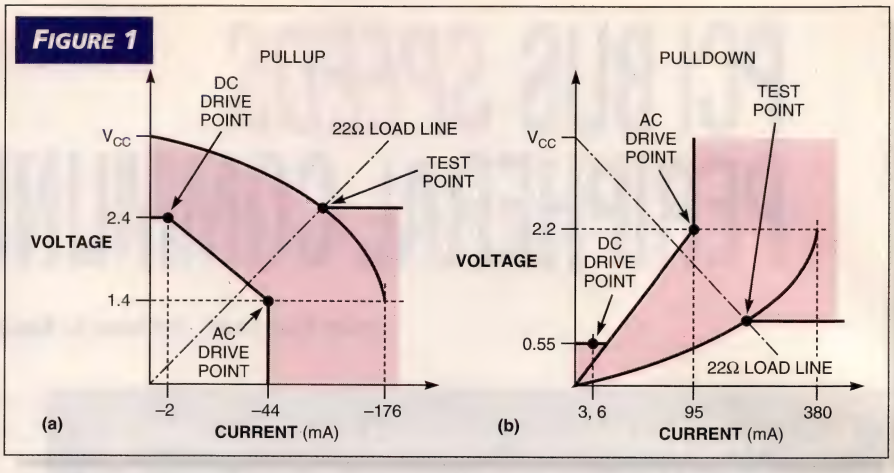
Attaching a peripheral device to the PCI bus requires an I/O-control chip that implements the PCI protocols on the PCI side and connects to a back-end bus on the reverse side. The PCI bus is an unterminated transmission line having CMOS loads. An unterminated bus uses reflective waves instead of incident waves to transfer data. A PCI driver has only to drive half the required high or low signal level of the receiver.

The incident wave travels down the bus, reflects off the unterminated end, and travels back to the receiver where the voltage doubles to meet the required input voltage. The propagation delay is a function of the electrical length of the bus and may last as long as 10 nsec, one-third of the clock period for 33-MHz operation.

The Intel Architecture Lab developed the PCI bus, but now the PCI Special Interest Group, comprising over 300 companies, promotes the bus as a nonproprietary standard. The specification outlines a 5 to 3.3V transition path by defining three types of PCI board connectors: 5V only, 3.3V only, and universal (5 and 3V). A connector keying system prevents users from inserting a board into an inappropriate slot. The group based the PCI drive requirements on

# PCI I/O CONTROLLERS

voltage-vs-current curves rather than dc-drive level (**Fig 1**). The rule of thumb is that a PCI line buffer should be able to drive 10 electrical loads, where a card connector counts as two loads.




**The voltage-vs-current-drive characteristics for a 5V device operating on the PCI bus must fall within the gray areas. A similar curve is specified for 3V signaling. (Courtesy of PCI Special Interest Group).**

### Sometimes called a buffer

A generic PCI controller contains the PCI interface, a FIFO or register buffer, a control unit for the back-end bus, configuration registers, and an optional expansion ROM. The controller maps the address space of one bus into the address space of the other and acts as an elastic buffer between two synchronous systems. It takes 47 pins to implement a target (slave) interface and 49 pins to implement an initiator (master) PCI interface, not counting power and ground pins. Assuming the back end has a 32-bit data bus and associated control and address buses, the number of I/O pins for the controller can exceed 100.

The PCI bus provides for autoconfiguration. Upon power-up, the system-level software identifies each PCI card and automatically configures the card, which eliminates the need for switches. To satisfy this requirement, the controller must contain a minimum of 64 configuration registers for ID purposes. **Fig 2** shows a suggested set of configuration registers, which occupy a 256-byte space.

The basic bus-transfer mechanism on the PCI bus is a burst, comprising an address phase followed by one or more data phases. The maximum number of burst data phases is 256. A PCI master must be able to perform burst reads and writes, address memory or I/O space, handle configuration accesses, respond to system reset, generate and check parity, generate parity errors, recognize a target (slave) abort, recognize a retry, and time out on a master abort. A target must be able to decode addresses, handle configuration accesses, respond to system reset, generate target aborts, generate retries, generate and check parity, and generate parity and system errors.

A bus master must arbitrate for each access it performs on the bus. The specification defines a central arbitration scheme in which the master has unique request and grant signals. The scheme hides arbitration, which means that arbitration occurs during the previous access so that the arbitration phase doesn't consume PCI bus cycles. The designer must choose the arbitration algorithm from among rotating priority, fairness, or another algorithm.

### Choices are few

Unfortunately, few off-the-shelf products are meeting the emerging standards' need for a general-purpose

## CONNECTING THE PCI BUS TO STANDARD INTERFACES

Many applications don't require a general-purpose I/O controller to the PCI bus. Standards such as IDE disk drives, Ethernet LANs, and SCSI devices define the controllers for these applications. Many vendors offer standard PCI controllers for these applications. For example, Digital Equipment Corp offers the DECchip 21140 Fast Ethernet controller that connects directly to the PCI bus and has separate 10- and 100-Mbps ports. The $39.50 (5000) chip conforms to both the 10BaseT and 100BaseT network specifications.

NCR offers the 53C810 and 53C825 PCI-to-SCSI processors that connect directly to the PCI bus. The $27.30 (1000) 53C810 transfers data at 5 Mbytes/sec asynchronously and 10 Mbytes/sec synchronously. The $36.60 (1000) 53C825 transfers data at 10 Mbytes/sec asynchronously and 20 Mbytes/sec synchronously over the fast-and-wide single-ended or differential SCSI bus.

Future Domain also offers a single-chip SCSI-2 interface to the PCI bus for under $20. The 36C70 has a 2-kbyte FIFO buffer and can sustain 10-Mbyte/sec fast SCSI synchronous data transfers. Adaptec's AIC-7870 plugs directly into the PCI bus and transfers data to a fast-and-wide SCSI port at 20 Mbytes/sec. The $39 chip acts as a 32-bit PCI bus master.

Both Symphony Laboratories and Opti Inc provide PCI bus-to-IDE controller chips. The SL82C101P from Symphony Labs supports four IDE drives, offers IDE primary and secondary address selection, and includes an automatic standby mode for power savings. It costs $2.95 (10,000). The 82C621 from Opti Inc also supports four IDE drives and contains 16-byte read-prefetch and write-posting FIFO buffers that allow memory cycles to run concurrently with IDE cycles. The $6 chip can also be a master on the PCI bus and dump data directly to DRAM without CPU intervention.

Strictly speaking, the PCI bus is a mezzanine bus that incorporates bridge chips to interface to the host CPU and to other standard expansion buses. There are enough of these bridge chips to devote an article to them; that article will appear in the first quarter of next year.

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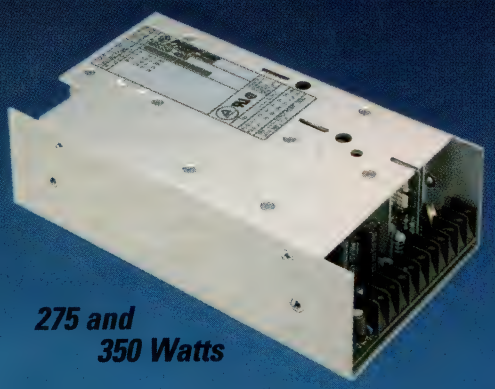

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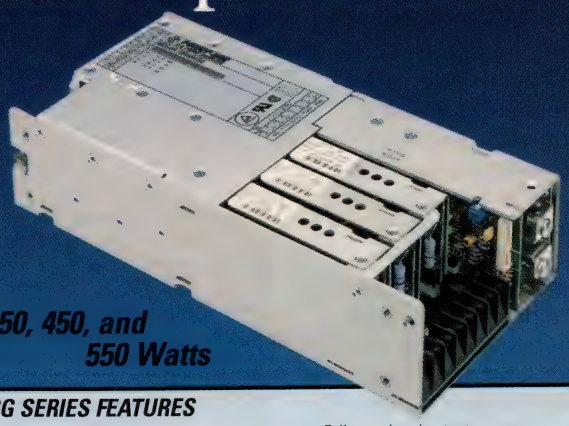

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| 275 | 5V@25A | 12V@10A | 12V@6A | 5V@2A | NRG275-4000 |
| 275 | 5V@25A | 12V@10A | 12V@6A | 12V@2A | NRG275-4001 |
| 275 | 5V@25A | 12V@10A | 12V@6A | 24V@2A | NRG275-4002 |
| 275 | 5V@25A | 12V@10A | 12V@6A | 48V@1A | NRG275-4003 |
| 350 | 5V@35A | 12V@10A | 12V@6A | — | NRG350-3000 |
| 350 | 5V@35A | 12V@10A | 12V@6A | 5V@3A | NRG350-4000 |
| 350 | 5V@35A | 12V@10A | 12V@6A | 12V@3A | NRG350-4001 |
| 350 | 5V@35A | 12V@10A | 12V@6A | 24V@3A | NRG350-4002 |
| 350 | 5V@35A | 12V@10A | 12V@6A | 48V@1A | NRG350-4003 |
| 350 | 24V@10A | 5V@10A | 15V@4A | 15V@4A | NRG350-4201 |

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# PCI I/O CONTROLLERS

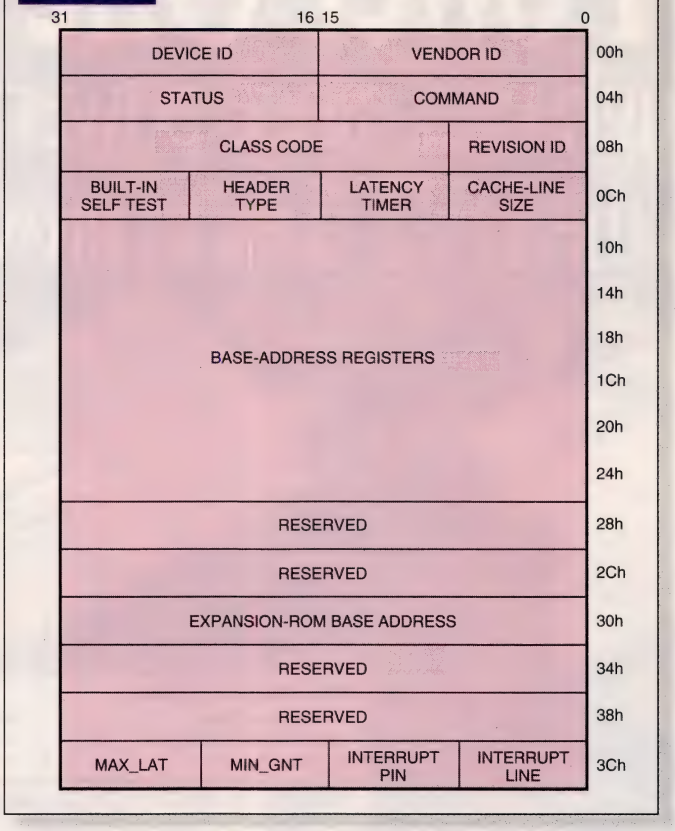
I/O controller; however, some are available. For example, Applied Micro Circuits Corp (AMCC) offers the S593X series of general-purpose PCI bus controllers. Code-named the "PCI Matchmaker," the S593X provides three physical-bus interfaces: the PCI bus, the back-end bus, and an optional external, nonvolatile memory bus. In addition, to comply with the PCI specification, the S593X maintains 256 configuration registers, which the host system can control.

The S593X can become a bus master on the PCI bus or serve as a target (slave) for modest data-transfer requirements. Data transfers between the PCI and back-end buses can take place through bidirectional mailbox registers, through bidirectional 32-bit FIFO buffers, or through a pass-through data path. Mailboxes initiate large data transfers over either the FIFO buffers or the pass-through data path. The pass-through feature achieves burst transfers between the PCI bus and the back-end bus or memory peripherals. One address register and two data registers (one for each direction) comprise the pass-through logic.

An important feature of the S593X is its ability to perform various endian translations when data moves through the FIFO buffers. The feature allows an add-on product to maintain its own fixed endian mode while the system operates in its native endian mode.

Chip select and either a read or write strobe accomplish data transfers between the back-end bus and the S593X's internal registers. The output pins on the back-end bus include an interrupt pin, a buffered clock line, and a software-controllable reset. The interrupt output pin signals when a selected mailbox or self-test event occurs from the PCI interface. The buffered clock provides synchronization for pass-through data transfers. The S5933, which has a 32-bit back-end data path and comes in a 120-pin PQFP, costs $39.95.

**FIGURE 2**




**The PCI specification recommends a 256-byte configuration-register space, the first 64 registers of which are mandatory. All multibyte numeric fields follow little endian ordering. (Courtesy of PCI Special Interest Group)**

If AMCC's S593X doesn't meet your needs, you can roll your own general-purpose PCI controller with such products as LSI Logic's PCI-32 FlexCore building block, which the company includes in its CoreWare program. You can connect the building-block core to other building blocks in a library of cores to create an ASIC that fits your application. The PCI-32 FlexCore contains six modules that provide a complete PCI interface: a master, a slave, configuration registers, FIFO control, FIFO buffer, and a nonmultiplexed on-chip interface to a VL-like back-end bus.

The PCI-32 FlexCore operates at a clock rate as fast as 33 MHz on its 32-bit interface to the PCI bus. The back-end interface operates synchronously with the PCI clock or asynchronously at 16 to 40 MHz. You can program the internal FIFO buffer to be four, eight, 16, 32, or 64 double words. The VL-like back-end interface connects to the PCI bus via the internal bidirectional FIFO buffer. The VL-like interface supports a VL master or slave and other VL bus functions. You can add the PCI-32 FlexCore to a CoreWare library for an access fee of $40,000.

Alternatively, you can use a PLD or an FPGA (field-programmable gate array) to create a general-purpose PCI

## LOOKING AHEAD

PCI bus controllers exist for computers having standard interfaces, such as LANs, IDE drives, graphics devices, and SCSI devices. However, if you need to connect a nonstandard device to the PCI bus, you have limited choices. Because less than a handful of companies offers general-purpose controllers, you may have to build your own. As more designers want to attach disparate devices to the PCI bus, companies will begin to provide general-purpose controllers.

One motivation to supply these controllers may be the 64-bit extension to the bus that theoretically increases the bus bandwidth from 132 to 264 Mbytes/sec. Although most of today's designs are 32 bits wide and, therefore, fit the standard bus controller, a 64-bit bus controller would require special interfaces to reap the benefits of the increased bandwidth.

Another motivation for a general-purpose interface is the proposal to run the PCI bus at 66 MHz instead of 33 MHz. This extension will stretch standard I/O controllers and generate the need for a more general-purpose I/O controller.

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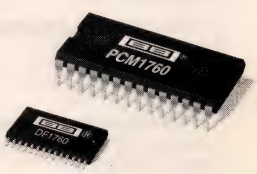


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## PCI I/O CONTROLLERS

controller. The PCI bus is complex, however, and requires a large and fast programmable device or multiple devices to implement the interface. A number of PLD and FPGA vendors consider some of their devices to be PCI-compliant. Because the PCI bus guarantees low latency, a programmable device must meet the PCI bus specification's stringent requirements. For example, the clock to signal a valid delay for bused signals must be less than 11 nsec, the input setup time for bused signals to the clock input must be a minimum of 7 nsec, and the input hold time from the clock input must be 0 nsec.

In addition, the input capacitance for each bused signal must be 10 pF or less, and the input capacitance for the clock line must be 12 pF or less. You cannot daisy-chain the clock line, but you must instead distribute it via separate transmission lines to each load with less than 2-nsec skew. Stringent requirements also exist for the signal rise and fall time (less than 4 V/nsec) and the ac/dc switching currents when the bus is signaling. At least three programmable-logic vendors claim that their parts meet all the PCI requirements—Altera, AT&T, and Xilinx.

Altera offers the MAX 7000 and Flex 8000 families of erasable PLDs (EPLD), which are PCI-compliant. In addition, Altera has obtained the rights to Intel's Flexlogic FPGA family, which includes the FX8160 complex PLD (CPLD) for creating PCI controllers. The FX8160 offers 160 macrocells of logic comprising 16 configurable function blocks (CFB). You can configure each CFB independently as a 24V10-type PLD or as a 128-bit-wide SRAM.


**Applied Micro Circuits Corp's S5933Q is one of the few off-the-shelf general-purpose PCI I/O-controller chips. The device provides a complete 32-bit PCI bus-to-32-bit back-end bus interface.**

You can use the SRAM for the configuration registers and arrange the memory into an elastic FIFO buffer. To meet the high I/O demands of a PCI controller, the 208-pin FX8160 package provides 120 I/Os and 48 dedicated inputs for a total of 168 I/Os. This number satisfies the I/O demands of a PCI controller and allows for additional logic. You can download macros for a general-purpose PCI controller from Altera's bulletin-board system. A 10-nsec version of the FX8160 costs $165 (100).

AT&T's Optimized Reconfigurable Cell Array (ORCA) family of 0.5-µm CMOS FPGAs offers 12,000 to 26,000 usable gates and as many as 384 usable I/O pins. One member of the family, the ATT2C26, has 26,000 gate equivalents and meets the ac/dc drive requirements of the PCI specification. The $720 (1000) chip also features on-chip SRAM for the configuration registers. The ORCA series features three levels of metal to connect

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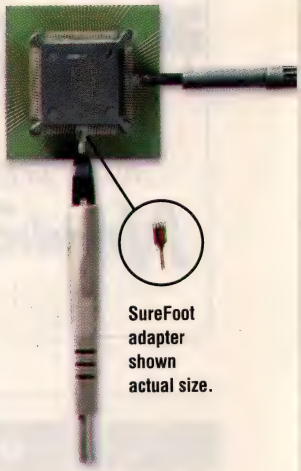

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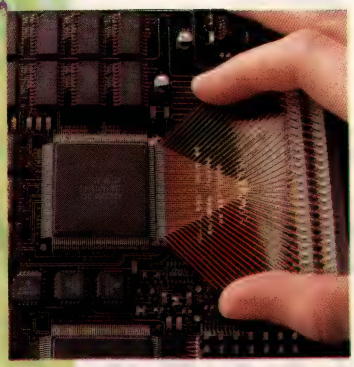

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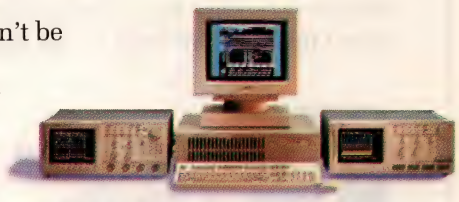

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## PCI I/O CONTROLLERS

gates, which provide a high degree of routing flexibility. This flexibility is why Logic Innovations Inc chose the ORCA family for designing PCI controllers. ORCA's routing flexibility eases handling of the PCI functions such as STOP, which indicates the target is requesting the master to stop the current transaction.

You can also design a flexible PCI controller using Xilinx's XC7300 family of EPLDs. Xilinx is so sure that its 10-nsec version of the XC73108-10 EPLD is PCI-compliant, the company publishes a 5-pg checklist showing 56 electrical points where the EPLD meets PCI compliance. Dual-voltage I/O drivers let you develop a "universal" expansion adapter card that operates in a 5 or 3.3V PCI signaling mode.

In a typical design using the Xilinx EPLD family, an XC73108 functions as the PCI bus interface, an XC7354 functions as the error handler, and an XC3190A functions as a memory and back-end controller. You simply add FIFO buffers to complete the design. The company provides VHDL and ABEL source code for the design. You can also drop in the XC7314 as a pin-compatible replacement for the XC73108, which can integrate the XC7354 into a single device. You can employ unused logic in the XC7314 to implement a latency timer and target locking. A 10-nsec XC7310-10 has 108 macrocells and comes in a 160-pin PQFP. It costs $52.81 (1000). EDN

### Reference


1. "PCI local bus gathers momentum," Gary Legg, *EDN*, Feb 3, 1994, pg 25.



*You can reach Technical Editor John Gallant at (617) 558-4666, fax (617) 558-4470.*


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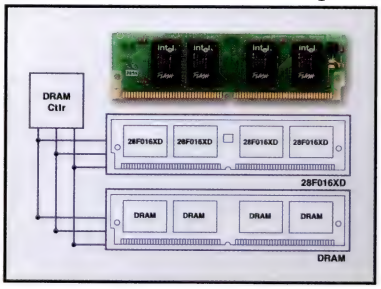
With higher densities, greater functionality and JEDEC standardization, Flash truly requires a shift in thinking about memory system architectures. Because a single Flash chip can do the work that used to require several kinds of chips. So read on, and discover why Flash memory goes above and beyond the rest.

## Flash Memory vs. DRAM+ROM

Flash technology is not only in high-volume production, but it's as fast or faster, and it's actually cheaper, than DRAM solutions. And the trend will just keep going as we continue to introduce smaller, faster and smarter devices.




Intel's new DRAM-interface Flash devices can be implemented on industry-standard SIMMs.

Because Flash is a nonvolatile memory solution, it can perform the function of code DRAM and nonvolatile backup storage in your design. Flash immediately eliminates the need for redundancy, allowing for instantaneous start-ups and an overall increase in system performance.

Our new Synchronous 33MHz Flash Memory solution, which can now reside on the processor local bus, approaches 2nd-level cache performance. It can eliminate DRAM+ ROM by executing code directly from Flash at faster-than-DRAM speed.

Beyond that, Intel even offers a new 16Mb Flash component that has a multiplexed address bus and is compatible with most DRAM RAS#/CAS# controllers, so you can get your hardware design up and running quickly, leaving more time for software development.

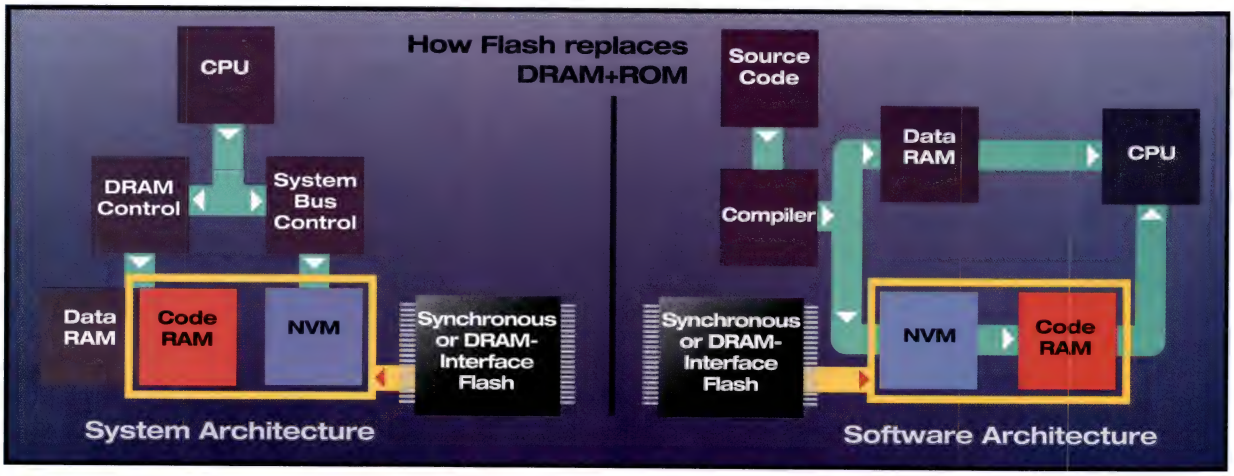
And there is no constraint on Flash components. Intel is at full production all the way up to 32Mb.

## Flash Memory vs. battery-backed RAM

Flash is an excellent alternative to battery-backed RAM (such as SRAM) being used as a nonvolatile solution. Flash memory is about one third of the cost, and that doesn't even include the battery.

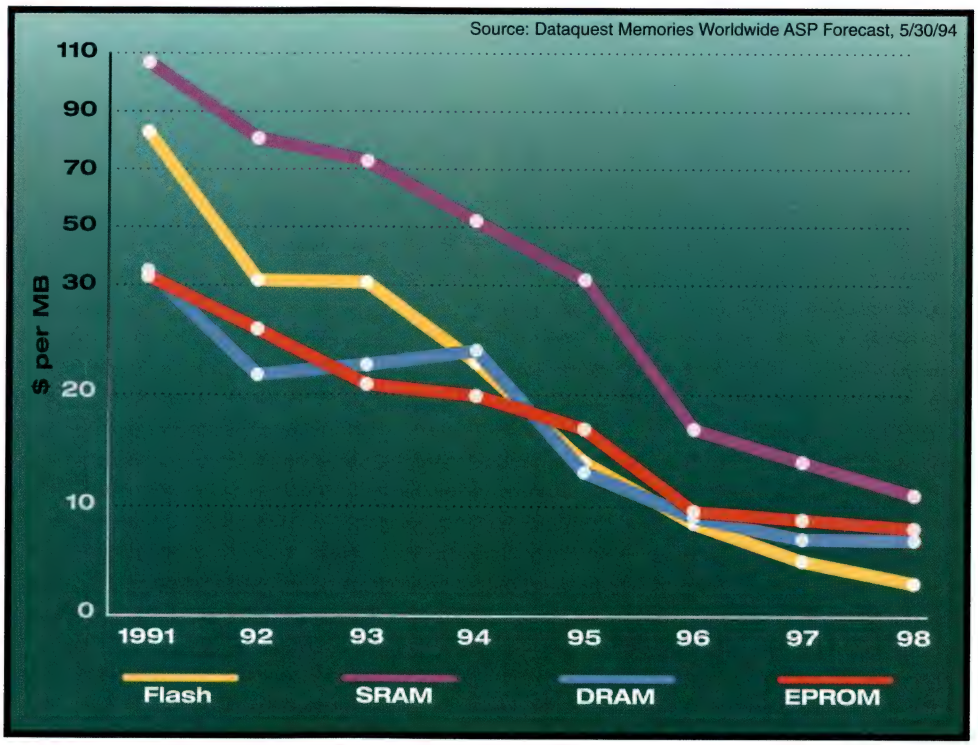
By eliminating the backup

Intel Flash Memory, such as our new 16Mb 33MHz Synchronous Flash or 16Mb DRAM-interface Flash, can help you build more efficient designs. A single Intel Flash chip can replace the combination of DRAM for code execution and redundant nonvolatile memory (NVM) for code storage.



### Memory Technology Cost Comparison

Since 1988, Intel's ETOX™ manufacturing process has helped the cost/megabyte of Flash memory drop to the point where it is now a more cost-effective solution than DRAM, SRAM, or EPROM.




battery+RAM with Flash, you no longer have to worry about battery failure resulting in a loss of data. Flash also allows you to build a more power- and space-efficient design.

Flash has an 8x density advantage over SRAM. So in some applications, you can replace all of your battery-backed SRAM in one block of an Intel Boot Block Flash chip. The rest of the chip can be configured for boot code, BIOS, whatever you want. And in the end, your chip inventory and cost per design go down, and you have a more flexible, reliable solution.

### Flash Memory vs. EPROM

In today's competitive time-to-money race, using Flash over EPROMs is like giving yourself an insurance policy against missing your design schedule. Because Flash is in-circuit reprogrammable, a feature that will save your company time and money on both ends of the design cycle.

In-circuit programming means Flash is much cheaper and faster to prototype and debug. And it allows you to respond to last-minute marketing requests. Flash-based systems can also be test-code programmed to test your systems online, then reprogrammed with production code on their way out the door, thus maintaining a just-in-time inventory. Using Flash memory, you could even move up your launch dates.

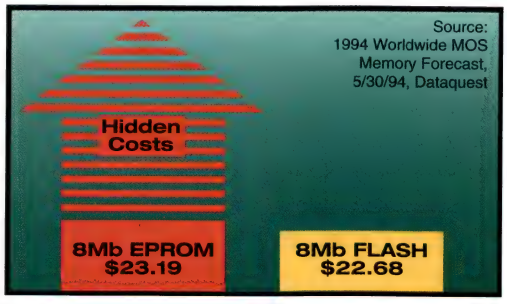
And when you need to upgrade already-shipped systems to stay competitive, all you have to do is pop in a diskette or connect to a comm-link. No more expensive service calls, system disassembly or hassles with UV erasing. Customers will appreciate the reduction in downtime, too.

Amazingly enough, Flash and EPROMs are at comparable prices at 8Mb and above. Yet Flash also offers features like SmartVoltage and memory integration that you'll never find in EPROMs. And Flash is completely scalable to 32Mb and beyond, while higher-density EPROMs become increasingly difficult to obtain.

### Intel Flash vs. Flash

There are many reasons to take a long look at Intel when you are considering which Flash memory to choose. Many of those reasons have to do with the fact that Intel is the company leading the technology forward.

Chip by chip, feature by feature, nobody can match our technology. Nobody can match our breadth of products. Nobody can outsupply us. And nobody can match the




In 1994, Flash prices actually went below the forecast cost of EPROMs. Yet Flash memory also saves you the enormous hidden costs of service calls, updates, debugging, prototyping and testing that usually come with EPROMs.

### Intel Boot Block component family

Currently available in densities from 1 to 4Mb, with 8Mb coming in '95, Intel's Boot Block architecture is designed with asymmetrical blocks so you can set aside and lock one smaller block specifically to protect code. The rest of the blocks can be written and erased at will.

Boot Block components offer fast access times of 60ns for zero-wait-state operation in systems driven by fast processors. They are very power-efficient, offering 3.3V capability and a deep power-down mode to extend battery life in portable systems.

Intel Boot Block Flash chips are user-configurable for either x8 or x16 applications. And they come in both industry-standard PSOP and TSOP pinout options.

### Intel Bulk Erase Flash components

These components range from 256K to 2Mb. They include a quick-pulse programming algorithm to make in-circuit programming fast and reliable. And the components can typically be erased electronically in one second, so code updates are easy.

They offer read performance as fast as 65ns. They also have very low, CMOS-like power consumption to extend battery life—usually a 10mA active current.

### Intel 2-40MB PCMCIA Flash Cards

With Intel Series 2 and 2+ Flash Cards, you can create


mobile systems that will run all day on AA batteries, and embedded storage expansion that will last the life of your system.

Intel Series 2+ Flash Cards offer auto-switching between single-supply operation of 3.3 or 5V, as well as dual-voltage operation. They also have a 12µA deep power-down mode, 150ns read times and a write transfer rate of 0.85MB per second. And with up to 1 million write-erase cycles per block, they're a lot more reliable than rotating storage media.

### Intel 5 & 10MB PCMCIA/ATA Flash Drives

Intel Flash Drives are built for design simplicity.


In fact, they are O/S independent, so they plug directly into PCMCIA, ATA or IDE hard drive sockets with no extra software, giving you the immediate benefits of compact, solid-state Flash memory.

Intel Flash Drives are 10x more energy efficient than HDDs, offering an auto power-management mode of <15mW, and extending battery life as much as 2x.

### We're raising the standard of memory design

As a designer, the pressure to build new, innovative systems—and to build them fast—seems to be getting more intense. Intel Flash Memory can help put you above your competition.

Call the numbers below for detailed information about individual Intel Flash components, service and support, and to find out how to get samples. Consider Flash Memory from Intel, and together, we'll take your designs to the top.

**1-800-879-4683, ext 242.**

Call the number above for more information about any of Intel's Flash products or tools.
For information via FaxBack*call 1-800-628-2283 and request doc. #2268.
For technical assistance and the names of Intel Flash distributors,
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way we build our devices. Let's look at manufacturing and at some new Flash technology breakthroughs from Intel.

## Manufacturing process and capacity

Manufacturing is at the heart of how we are able to produce compatible, scalable, denser, and more reliable Flash chips. In fact, we've been perfecting the process since we began building EPROMs in 1971.

Today, we build chips using our 4th-generation 0.6µ ETOX™ process technology, which combines state-of-the-art EPROM programming methodology with EEPROM-like in-system electrical erasure. These, along with years of manufacturing, electrical-test and temperature-stress expertise, yield a memory that is very manufacturable, highly reliable, extremely stable, and cost-effective to produce. ETOX also enables specific devices with extended temperature ranges for harsh operating environments.

As evidence of that, Intel has shipped in excess of 100 million units—more than all of the other Flash manufacturers combined. And we've brought multiple Flash factories online to provide more than one source for supply.

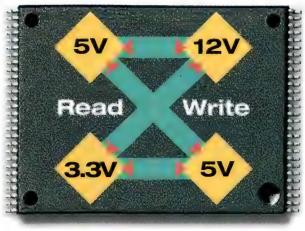
## New Intel SmartVoltage technology

Intel SmartVoltage technology is a quantum leap beyond any other Flash solution, making Intel Flash the lowest-power, most flexible solution available. SmartVoltage technology


Our SmartVoltage 4Mb Boot Block part, which is pin-compatible from 2 to 8Mb, is quickly becoming the industry standard for mid-density Flash.

offers dual-supply pinouts that let designers select the integration of a 5V-only system, the power savings of 3.3V logic or the high performance of a 12V write operation.

SmartVoltage technology works like this: First, for systems supplied only by 5 volts, SmartVoltage Flash chips end the need for a separate 12V source. Instead, they generate 12V internally with an on-chip charge pump.




New SmartVoltage technology lets you mix and match read/write voltages to best meet your design requirements.

Second, in portable equipment, where low power consumption extends battery life, SmartVoltage Flash chips offer a separate 3.3V read line. This slashes the power consumed for read operations by as much as 66 percent over 5V chips. Moreover, future SmartVoltage devices will yield a 2.7V read capability.

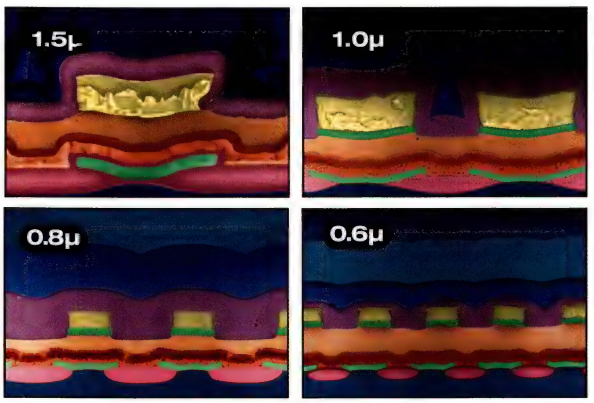
Third, in real-time systems where high performance is often a designer's first priority, SmartVoltage chips offer the speed of 12V write cycles. The higher write voltage also speeds the manufacturing process, shortening the system assembly throughput time. Once programmed at the higher rate, SmartVoltage Flash chips can work in any of the three scenarios.

Currently being sampled on the new Intel 16Mb 28F016SV Flash Memory chip, SmartVoltage technology will soon be available with pin-compatible 2, 4, and forthcoming 8Mb Boot Block Flash components.

Intel is charging no price premium for this technology for equivalent speed bins and read voltages. So you can design with 2, 4 and 16Mb chips today and plug in SmartVoltage chips at no extra cost as they become available.

## Revolutionary new Multilevel Cell technology

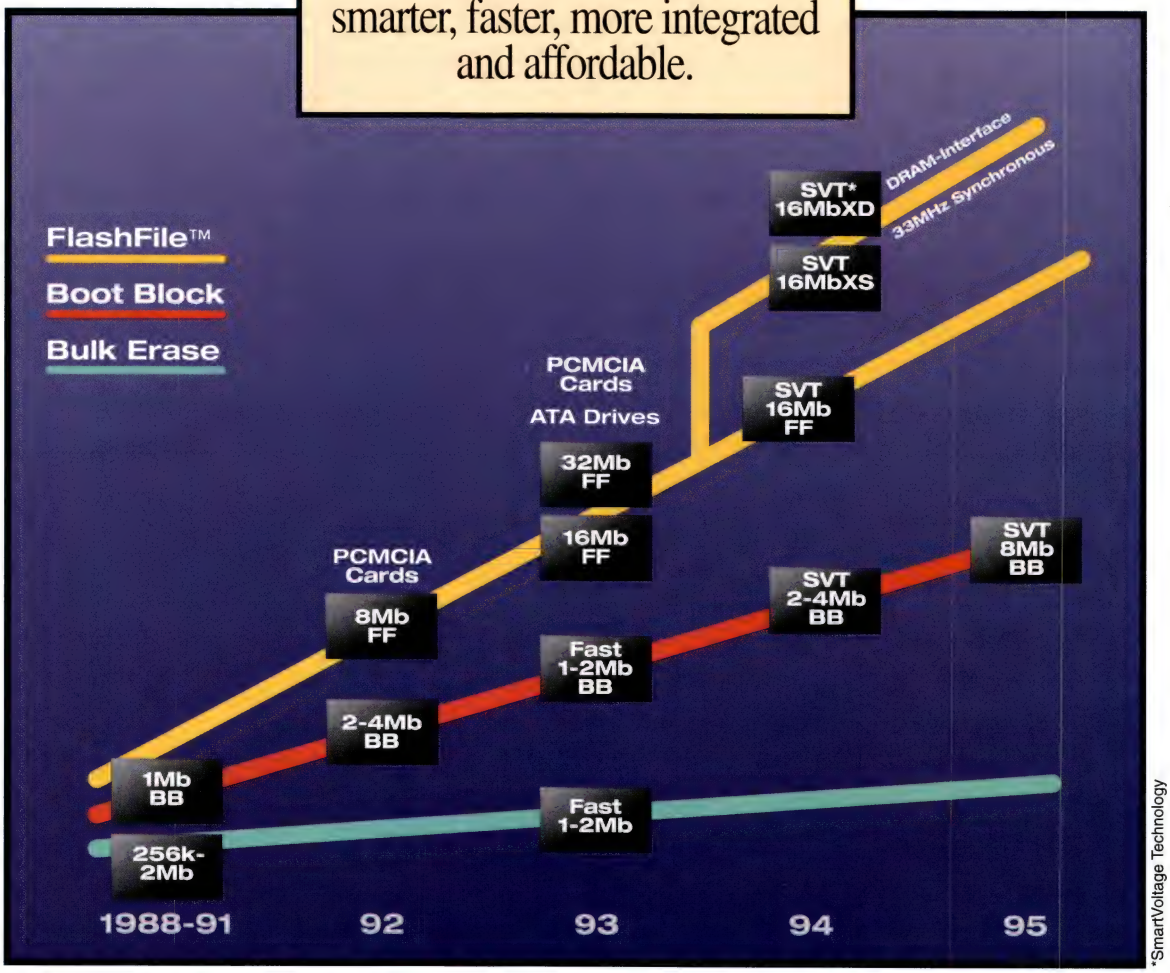
Intel Flash has an exciting technology on the horizon. Our ETOX process enables Multilevel Cell Flash—a breakthrough that will create two bits per Flash cell, effectively doubling the storage capacity of Flash chips. And where there will be two bits per cell soon, three bits will be possible later, and so on. This promises to push Flash densities way up, while the cost per megabyte drops dramatically over time. And by the end of the decade, this technology will yield a one gigabit Flash chip.




### The Evolution of ETOX™

Enabling the smallest Flash cell size ever, Intel's 4th-generation 0.6µ ETOX™ process yields Flash chips that are scalable, reliable and increasingly dense and feature-rich. And in 1996, Intel Flash chips will be produced on 0.4µ ETOX process.

# The Intel Flash family. Ever smarter, faster, more integrated and affordable.




*SmartVoltage Technology

## 8, 16 and 32Mb FlashFile™ components

This is the high-integration branch of the Intel Flash family, helping you reduce chip counts to build smaller, lighter systems.

Intel currently offers six FlashFile™ components. Three of those have new SmartVoltage technology, which gives you the flexibility of designing for any number of different power requirements, from low power to highest performance.

FlashFile components are made of symmetrical, in-system programmable blocks, which are lockable at densities of 16Mb and above to protect code from accidental erasure. They offer fast reads and page-buffer writes, and up to 1 million write and block erase cycles, making them extremely reliable.

What's more, FlashFile chips are now competitive with DRAM pricing, making them a more flexible, nonvolatile alternative.

## New 33MHz Synchronous16Mb Flash Memory

Intel now offers a new generation in high-performance Flash technology for embedded systems, the 16Mb 28F016XS component. With 16 symmetrical 128K blocks, this chip has similar features to the 16Mb SmartVoltage part, along with a revolutionary dual-bank architecture that makes zero-wait-state, 5V operation to 33MHz possible, and decreases its effective access time to 30ns.

This burst-interface technology utilizes dual internal memory banks, allowing operations to occur twice as fast, thus increasing performance beyond that of standard DRAM. This new high-speed Intel Flash chip is fully compatible with slow/stop clock systems, and is software compatible with Intel's current 16Mb FlashFile Memory offerings.

## New DRAM-interface 16Mb Flash Memory

This new component, the 28F016XD, offers the advantage of direct DRAM+ ROM replacement for code execution in highly integrated embedded systems. Along with SmartVoltage capability, it has a multiplexed address bus and RAS#/CAS# control inputs, making it simple to design in. It is compatible with most DRAM controllers, and it supports standard/fast page mode functions. It's also software compatible with Intel's current 16Mb FlashFile component family.

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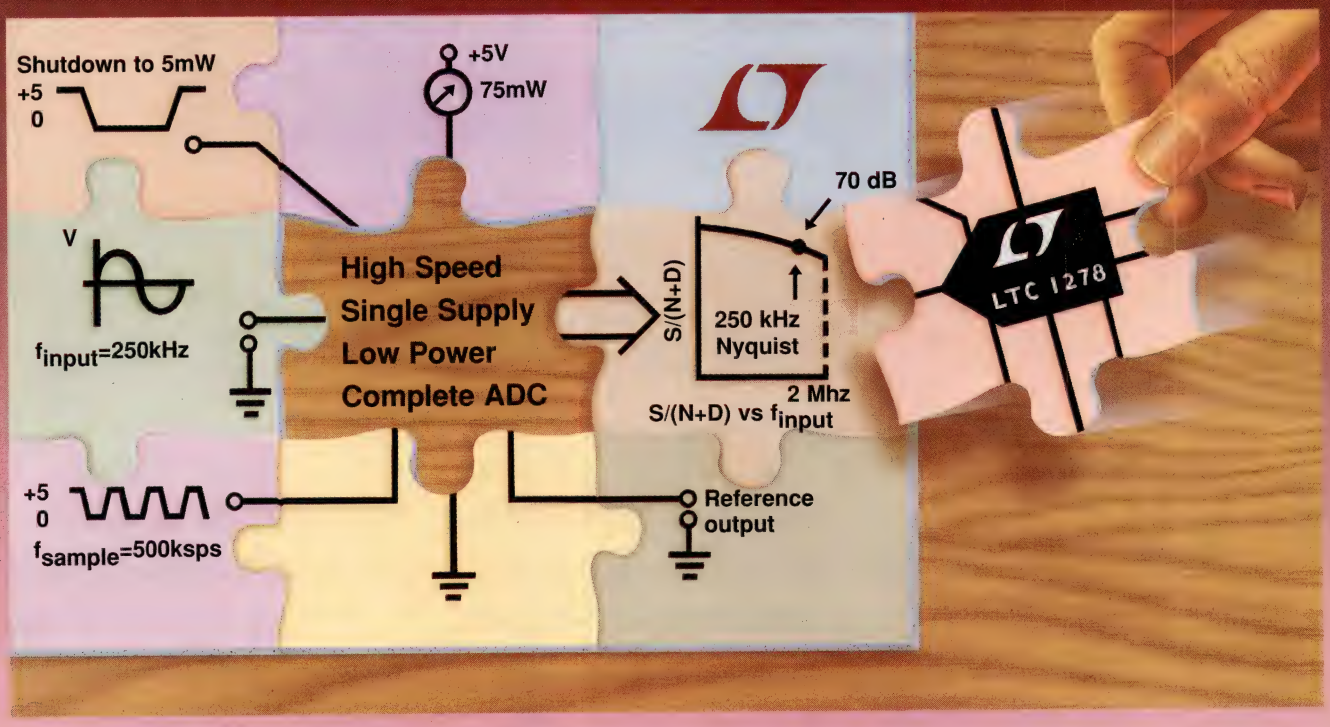
# The Missing Piece To Your A/D Converter Puzzle.




## The LTC1278: 12-Bits, 500ksps, single supply and shutdown. The perfect fit.

Linear Technology brings you the LTC1278, the perfect fit for your high speed data acquisition application. Fully specified for dynamic and static applications, the LTC1278 offers true 12-Bit performance while reducing your power and cost budgets.

| DEVICE TYPE | SAMPLE RATE | S/(N + D) @ NYQUIST | POWER SUPPLY | POWER DISSIPATION | 1000+ $ |
|---|---|---|---|---|---|
| LTC1272 | 250ksps | 65dB | 5V | 75mW | 10.64 |
| LTC1273 | 300ksps | 70dB | 5V | 75mW | 11.75 |
| LTC1275/76 | 300ksps | 70dB | ±5V | 75mW | 11.00 |
| **LTC1278** | **500ksps** | **70dB** | **5V or ±5V** | **75mW 5mW*** | 12.85 |
| LTC1282 | 140ksps | 68dB | 3V or ±3V | 12mW | 13.47 |

*power down mode

**Get Better Performance.** Outstanding AC performance includes 70dB S/(N+D) and 77dB THD at Nyquist. The wide bandwidth Sample and Hold allows signals as fast as 1MHz to be under sampled with remarkable spectral purity.

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CIRCLE NO. 96

# Battery-powered sensor detects dangerous UV radiation

JOERG HOLLMANN, HUGHES LEITZ, ON, CANADA

The battery-powered circuit in Fig 1 detects 295-nm UV radiation, which is dangerous to eyes and skin. Be sure to protect yourself and your coworkers against this radiation.

To operate the device, press switch $S_1$ and hold it closed for at least 2.2 sec. A start pulse applied to $IC_4$ starts the 2.2-sec measuring cycle. Pin 3 of $IC_4$ resets the 4040 binary counter, $IC_5$.

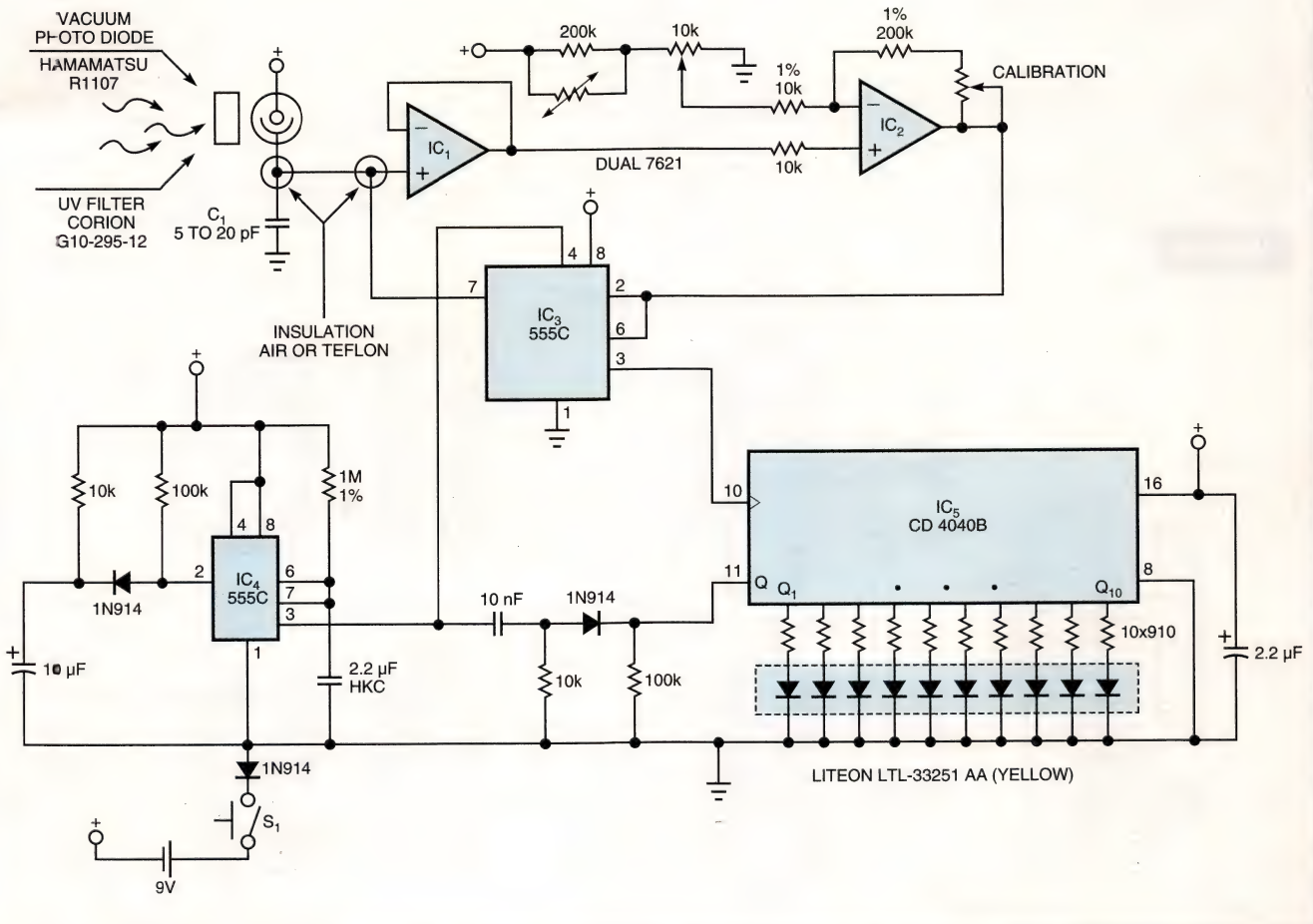
UV radiation at 295 nm generates a current in the R1107 vacuum photodiode. This photo current charges $C_1$ in a linear fashion. Size $C_1$ to suit your application; values should range from 5 to 20 pF. $IC_1$ is a high-impedance buffer amplifier, and $IC_2$ is a noninverting amplifier having a gain of ~20.

The amplified, linearly increasing voltage triggers 555 timer, $IC_3$. If the ramp voltage reaches two-thirds of the supply voltage of $IC_3$, $IC_3$ generates an output pulse into pin 10 (CLK) of the 4040 counter, $IC_5$, and discharges $C_1$ via $IC_3$'s Pin 7. This cycle repeats until $IC_4$ times out and its Pin 3 goes low. The counter $IC_5$ holds the radiation count and drives the LED array.

If the sensor detects no 295-nm radiation, the counter nonetheless displays 1 bit. This single count verifies that the battery can still power the circuit. (DI #1629) EDN

**To Vote For This Design, Circle No. 339**

**FIGURE 1**




**The counter, $IC_5$, measures 295-nm UV radiation by counting the number of times the R1107 UV detector can charge up capacitor $C_1$ during a fixed period.**

# POST repeater reads out remotely

**JERZY R CHRZASZCZ, INSTITUTE OF COMPUTER SCIENCE**
**WARSAW UNIVERSITY OF TECHNOLOGY, WARSAW, POLAND**

BBS

Commercially available power-on self-test (POST) cards for PCs have onboard LED displays that show diagnostic codes during the PC's start-up. This arrangement is usually good enough. But if you were to try to use such a card to fix a crowded PC motherboard, you would appre-

## LISTING 1—HEX-TRANSCODER PLD LISTING

```
Pin 1 =  clock    ;      /* register clock                    */
Pin 2 =  sdin     ;      /* serial data input                 */
Pin 3 =  hex0     ;      /* input data nibble                 */
Pin 4 =  hex1     ;      /* .                                 */
Pin 5 =  hex2     ;      /* .                                 */
Pin 6 =  hex3     ;      /* .                                 */
Pin 7 =  mode     ;      /* operation: 0 = load, 1 = shift    */
Pin 11=  !oen     ;      /* output enable - should be low     */
Pin 12=  a        ;      /* LED display segments a..g         */
Pin 13=  b        ;      /* .                                 */
Pin 14=  c        ;      /* .                                 */
Pin 15=  d        ;      /* .                                 */
Pin 16=  e        ;      /* .                                 */
Pin 17=  f        ;      /* .                                 */
Pin 18=  g        ;      /* .                                 */

load  = !mode;
shift =  mode;
field hex = [hex3..0];
field dec = [da,db,dc,dd,de,df,dg];
field reg = [a.d,b.d,c.d,d.d,e.d,f.d,g.d];
field shr = [sdin,a,b,c,d,e,f];

table hex => dec
{
0 => 'b'0000001;  4 => 'b'1001100;  8 => 'b'0000000;  C => 'b'0110001;
1 => 'b'1001111;  5 => 'b'0100100;  9 => 'b'0000100;  D => 'b'1000010;
2 => 'b'0010010;  6 => 'b'0100000;  A => 'b'0001000;  E => 'b'0110000;
3 => 'b'0000110;  7 => 'b'0001111;  B => 'b'1100000;  F => 'b'0111000;
}
reg   = load & dec # shift & shr;
```

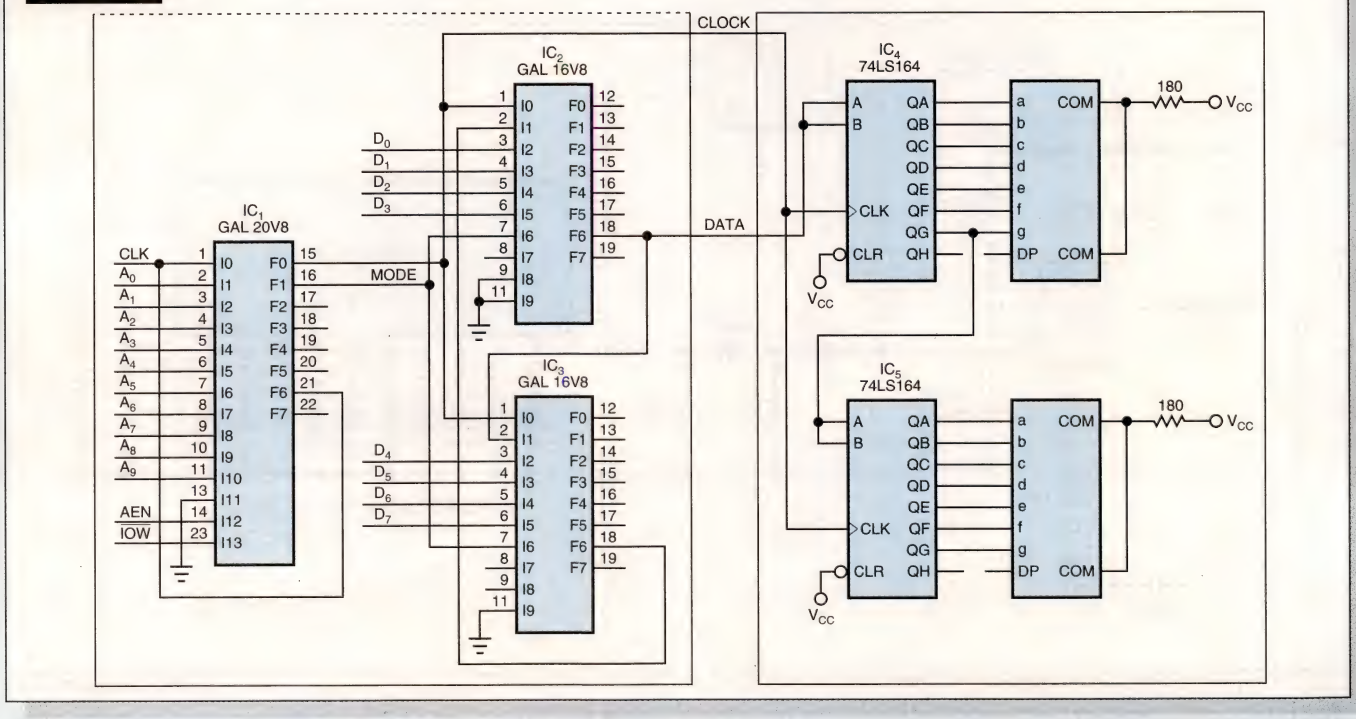
## LISTING 2—ADDRESS-DECODER AND STATE-MACHINE PLD LISTING

```
Pin 1 =  clk      ;      /* state machine clock                */
Pin 2 =  a0       ;      /* address lines                     */
Pin 3 =  a1       ;      /* .                                 */
Pin 4 =  a2       ;      /* .                                 */
Pin 5 =  a3       ;      /* .                                 */
Pin 6 =  a4       ;      /* .                                 */
Pin 7 =  a5       ;      /* .                                 */
Pin 8 =  a6       ;      /* .                                 */
Pin 9 =  a7       ;      /* .                                 */
Pin 10=  a8       ;      /* .                                 */
Pin 11=  a9       ;      /* .                                 */
Pin 14=  aen      ;      /* address enable                    */
Pin 23= !iow      ;      /* I/O write strobe                  */
Pin 13= !oen      ;      /* output enable - should be low     */
Pin 21=  clkin    ;      /* clock as input argument           */
Pin 15=  mode     ;      /* operation: 0 = load, 1 = shift    */
Pin 16=  clock    ;      /* output clock                      */
Pin 17=  q0       ;      /* state machine outputs             */
Pin 18=  q1       ;      /* .                                 */
Pin 19=  q2       ;      /* .                                 */
Pin 20=  q3       ;      /* .                                 */
Pin 22= !load     ;      /* load condition flag               */

$defineHOLD 'h'0
$defineLOAD 'h'1
$defineS1   'h'2
$defineS2   'h'3
$defineS3   'h'4
$defineS4   'h'5
$defineS5   'h'6
$defineS6   'h'7
$defineS7   'h'8
$defineS8   'h'9
$defineS9   'h'a
$defineS10  'h'b
$defineS11  'h'c
$defineS12  'h'd
$defineS13  'h'e
$defineS14  'h'f
field stat =[q3..0];
field addr =[a9..0];

load  = addr:80 & !aen & iow;
mode  = stat:[S1..S14];
!clock= stat:LOAD & load # stat:[S1..S14] & !clkin;
sequence stat
{       present HOLD
        if load next LOAD;
        default next HOLD;
present LOAD
        if !load next S1;
        default next LOAD;
present S1
        if load next HOLD;
        default next S2;
present S2
        if load next HOLD;
        default next S3;
present S3
        if load next HOLD;
        default next S4;
present S4
        if load next HOLD;
        default next S5;
present S5
        if load next HOLD;
        default next S6;
present S6
        if load next HOLD;
        default next S7;
present S7
        if load next HOLD;
        default next S8;
present S8
        if load next HOLD;
        default next S9;
present S9
        if load next HOLD;
        default next S10;
present S10
        if load next HOLD;
        default next S11;
present S11
        if load next HOLD;
        default next S12;
present S12
        if load next HOLD;
        default next S13;
present S13
        if load next HOLD;
        default next S14;
present S14
                next HOLD; }
```

**FIGURE 1**




**The power-on self-test card sports a remote readout of power-up error codes.**

# DIGITAL & ANALOG AUDIO FREQUENCY TESTING


# It's About Time

**Testing aircraft to automobiles, satellites to cell phones, headsets to hearing aids, SYSTEM ONE from Audio Precision saves you time...**

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ciate a detachable, remote display.

The circuit in **Fig 1** has two sections: an interface/transmitter board and a receiver/display board. On the interface/transmitter board, controller $IC_1$ contains an address decoder and a synchronous state machine. $IC_2$ and $IC_3$ are identical, registered seven-segment HEX transcoders. **Listings 1** and **2** contain these PLDs' specifications. The compressed ZIPfile attached to **EDN BBS /DI_SIG #1626** contains documentation, circuit diagrams, and listings.

When the PC's processor writes data to the diagnostic port (I/O location $80_{HEX}$), the interface/transmitter board sends the appropriate bit patterns serially to the receiver/display board. Note that $IC_2$'s data output connects back to the serial input of $IC_3$. So, after 14 clock ticks, $IC_3$ gets the original data back. Thus, $IC_3$'s parallel-segment outputs can drive an onboard display if you desire to add one.

The receiver/display board comprises two low-cost serial-in parallel-out (SIPO) registers, $IC_4$ and $IC_5$. Because the design transfers data serially, the remote display needs only a four-wire cable. (DI #1626) EDN

**To Vote For This Design, Circle No. 340**

# Summer linearizes ramp and triangle generators

***VALERY G CHKALOV, SCIENTIFIC ASSOCIATION "TYPHOON," OBNISK, RUSSIA***

The ramp generator in **Fig 1a** and the triangle-wave generator in **Fig 1b** charge capacitor $C_1$ linearly. The key to the circuits' linearity is an op-amp adder that sums a reference voltage with the voltage on $C_1$.

For **Fig 1a**'s ramp generator, the adder comprises op-amp $IC_1$, $R_4$, $R_5$, and associated components. The adder sums capacitor $C_1$'s voltage, $V_{CAP}$, via $R_4$ with a constant voltage, $V_{SET}$, via $R_5$. (Size $R_2$ through $R_4$ to suit your application.) The voltage at the output of the adder is thus

$$V_{CAP}+V_{SET},$$

and the voltage across resistor $R_1$ is

$$V_{CAP}+V_{SET}-V_{CAP}.$$

Because the adder holds the voltage across $R_1$ constant, a constant current flows through $R_1$, charging $C_1$ linearly. **Fig 1b** operates in a similar manner, except that comparator $IC_1$ switches the polarity of $V_{SET}$, ultimately producing a triangle-wave output. (DI #1631) EDN

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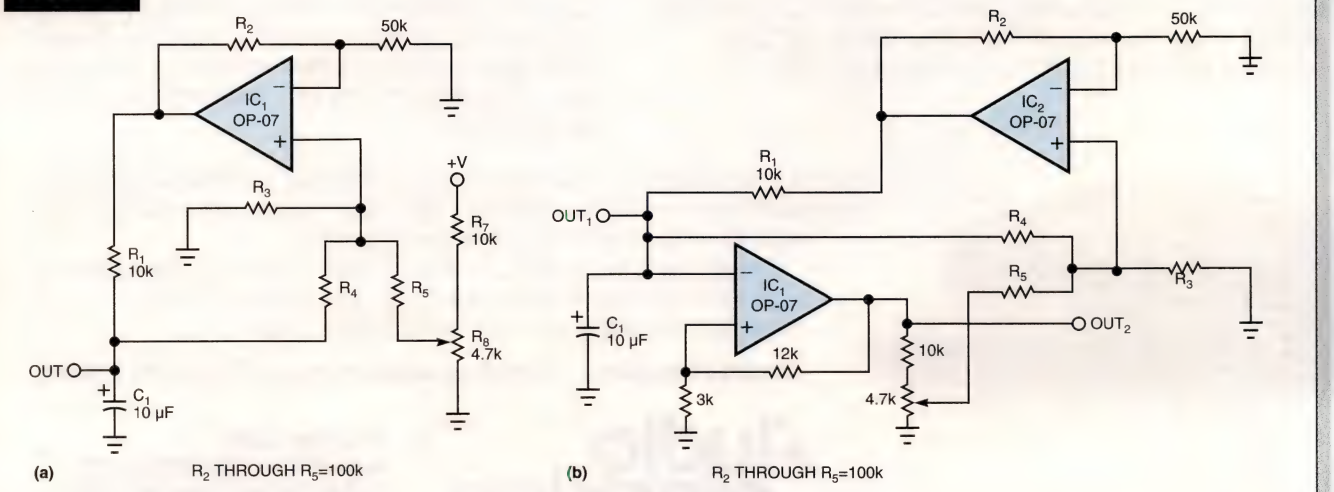
**FIGURE 1**




**An op-amp adder that sums a reference voltage with the voltage on $C_1$ allows the ramp generator in (a) and the triangle-wave generator in (b) to charge capacitor $C_1$ linearly.**

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F 71 Rev F

# FPGA's tri-state buffers build 32×32 crossbar

**BERNIE NEW, XILINX INC, SAN JOSE, CA**

A network of tri-state buffers in the XC4025 FPGA (field-programmable gate array) makes a 32×32-pair crossbar switch possible. The design uses input and output pipelining, and the crossbar switch's throughput is 100 Mbps for each 2-bit channel.

This design sets up the FPGA's programmable logic blocks in two configurations, replicated throughout the device's array (**Fig 1**). In each pair of the block's flip-flops, one flip-flop pipelines the data while the other stores the data-routing configuration. Vertical "long lines" bus input signals to groups of logic blocks. Local links cross-connect pairs of logic blocks. The cross-connection routes a pair of input signals through to one of the block's output signals.

The FPGA's programmable logic blocks have a pair of tri-state buffers as outputs. The buffers' outputs connect to a pair of horizontal "long lines" that run the full width of the device, connecting with I/O cells at the device's periphery. The device's 2048 tri-state buffers connect, in groups of 32, to a total of 64 long lines. Thus, you can route any one of the 32 pairs of inputs to any, or all, of the output long lines (**Fig 2.**)

Data transfers from each of the 32 pairs of inputs are independent. At any time, you can establish a connection from any input pair to any output pair not already in use, without affecting transfers in progress on other channels.

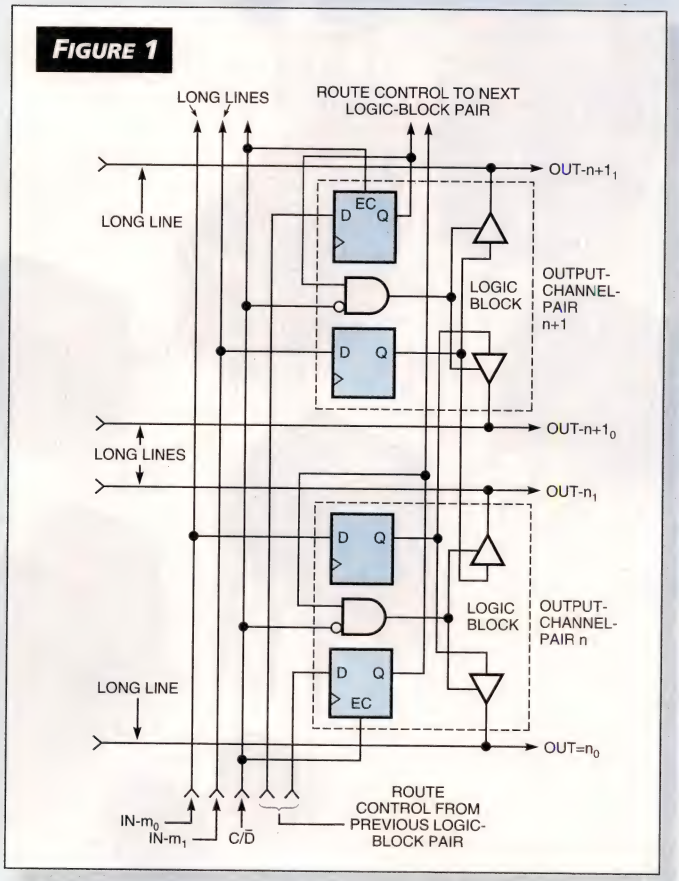
Incoming bit streams must carry routing information as well as data. The routing information is a 4-byte header that precedes the data. The FPGA stores the 4-byte header in what is, in effect, a shift register. This shift register comprises a chain of 32 flip-flops, with one flip-flop in each block of a string of 32 programmable logic blocks. The design handles the routing information two bits at a time. Configuration consumes 16 clock cycles in shifting the routing information to all the tri-state buffers. The routing information enables or disables the logic blocks as appropriate, before data transmission can begin.

The switch is fully multicasting because a single input can drive as many tri-state buffers as you wish. The 4-byte routing information is a simple 1-of-32 code for multiplexing or an *n*-of-32 code for multicasting.

You can combine the data and control inputs. The C/D control/data line passes input data to either the selected pair of outputs or to the control flip-flops. Asserting the C/D control/data line also puts a logic block's tri-state buffers into the high-impedance state. (DI #1632) EDN

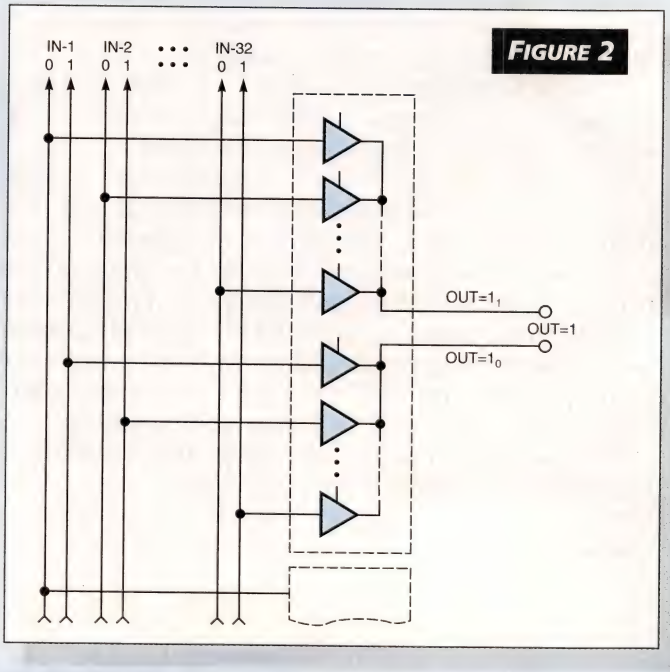
**To Vote For This Design, Circle No. 342**

**FIGURE 1**




**In each pair of the logic block's flip-flops, one flip-flop pipelines the data while the other stores the data-routing configuration for this 32×32-pair crossbar switch.**

**FIGURE 2**




**The logic blocks' tri-state output buffers connect to a pair of horizontal "long lines" that run the full width of the device.**

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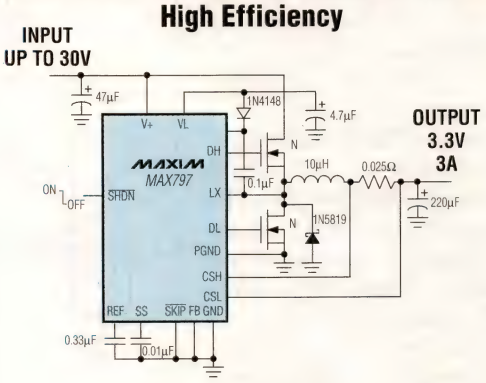
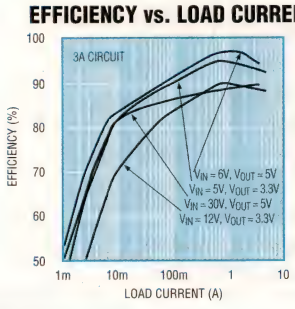
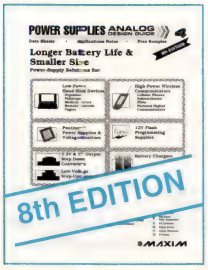



**EFFICIENCY vs. LOAD CURRENT**




*The MAX797 is configurable for 1A to 10A applications. Preselected component lists and supplier information are contained in the data sheet. 3A application is shown above.*

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# CMOS buffer delivers precise current pulses

**HARTMUT HENKEL, CONSULTANT, KRIFTEL, GERMANY**

The circuit in **Fig 1** delivers stable, fast-settling reference-current pulses. You can use the circuit in systems employing A/D, D/A, or V/F converters.

Digital input pulses, $V_P$, connect to $IC_{3B}$, a 74AC240 buffer. The 5.00V reference, $IC_1$, constrains $IC_{3B}$'s output, $V_R$, to either $V_{REF}$ or 0V. $IC_{3B}$'s rise and fall times are <3 nsec. Resistor $R_1$ converts the voltage at the output of $IC_{3B}$ to a current: $I_R=V_R/R_1$. $I_R$ flows into integrator $IC_4$'s virtual ground.

An analog control loop comprising $IC_2$ and $IC_{3A}$ stabilizes $V_{REF}$. The loop compensates for the 20Ω output resistance of buffer $IC_{3B}$. And, the loop reduces high-frequency noise from reference $IC_1$ (**Ref 1**). Diode $D_1$ prevents reverse polarity during power-up.

You should use tantalum capacitors for $C_1$ and $C_2$. Locate $C_2$ as close as possible to $IC_3$'s supply pins. If you use a low-temperature-coefficient Vishay (Malvern, PA, (610) 644-1300) resistor for $R_1$ and select 100 kΩ as the values for $R_1$, $R_2$, and $R_3$, $IC_1$ is the source of most of your current drift. (DI # 1635) EDN

## Reference

1. *Application note AB-003*, Burr-Brown Corp, Tucson, AZ. (602) 746-1111.

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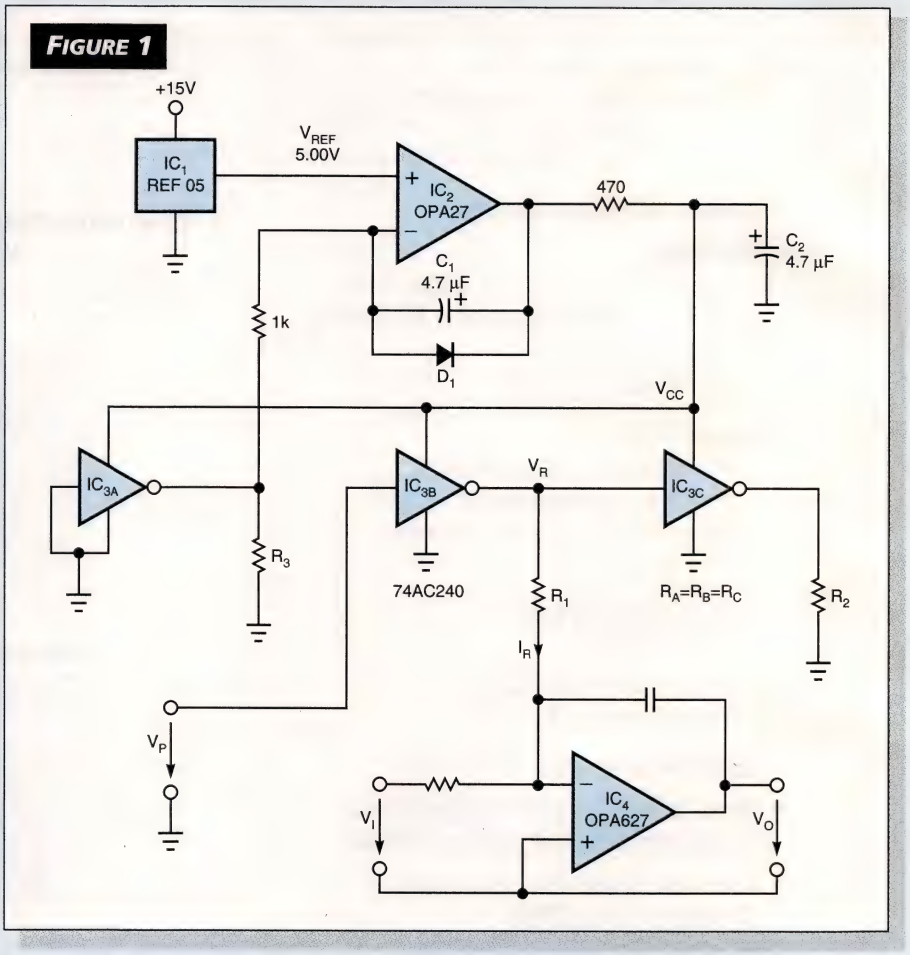
**FIGURE 1**




**This circuit delivers stable, fast-settling reference-current pulses because of its stable components and controlled-voltage level.**

# Repeating one-shot yields clean, stable pulses

**PHIL HARVEY, TECHNOLOGY INTEGRATION, BEDFORD, MA**

Now and then, you need a repeating one-shot, such as a *multi-shot*. For example, when an input logic signal or alarm condition occurs, you may need an immediate pulse to provoke a sequence that eventually resets the condition. But, if the resetting fails, you need to keep generating pulses until the message gets through. If you give up sending pulses, something as important as an entire space mission could have to wait for an automatic reset.

Although you can generate multiple reset pulses many ways, most methods are fraught with annoyances. The first pulse can be twice as long as the follow-on pulses. Or, as for the retriggerable one-shot, keeping the pulse generator on prolongs the pulse instead of making new ones. When turned off, the pulse generator sometimes cuts the last output pulse off, hatching short glitches.

The circuits in **Fig 1a** and **1b** are gated Schmitt oscillators. The oscillators respond to a negative input by producing a pulse of fixed length, regardless of how long the input stays on. The oscillators refuse to operate for a certain period. If the input is still there, the devices produce another pulse of the same fixed length.

In its quiescent state, the signal at the junctions is high (**Fig 1a**). $C_1$ couples the high-going transient to the diodes when the output toggles. The diodes clip the signal to 0.6V

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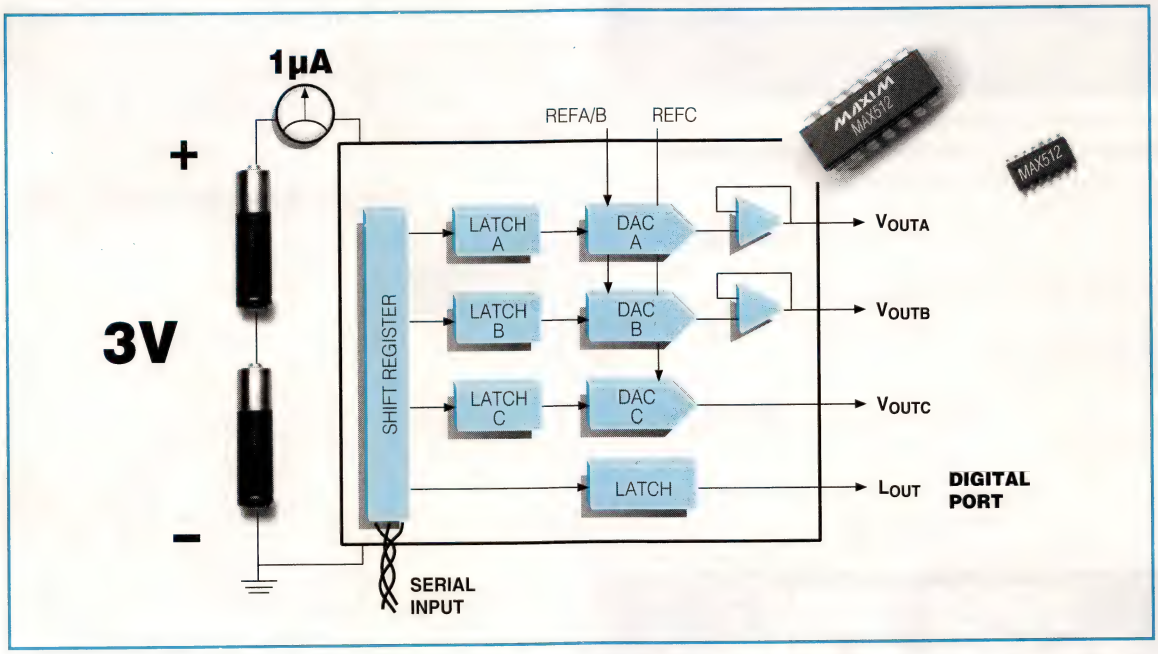


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above the positive rail. A relaxation cycle begins as $C_1$'s charge drains away, and its voltage heads for the Schmitt trigger's *lower* threshold.

When the circuit receives a continuous input signal, each subsequent relaxation cycle starts with the diodes driven high. The diodes start high, even through $C_1$'s voltage decays to the upper Schmitt level during the output pulse's on period. So, the circuit generates almost exactly the same pulse length every time, including the first time.

**Fig 1b**'s circuit, the simpler of the two versions, lacks clamping diodes and a transistor. The circuit's first pulse is slightly longer because the transition starts at a higher voltage. **Fig 1b**'s circuit is a trifle less temperature-stable than **Fig 1a**'s. (DI #1636) EDN

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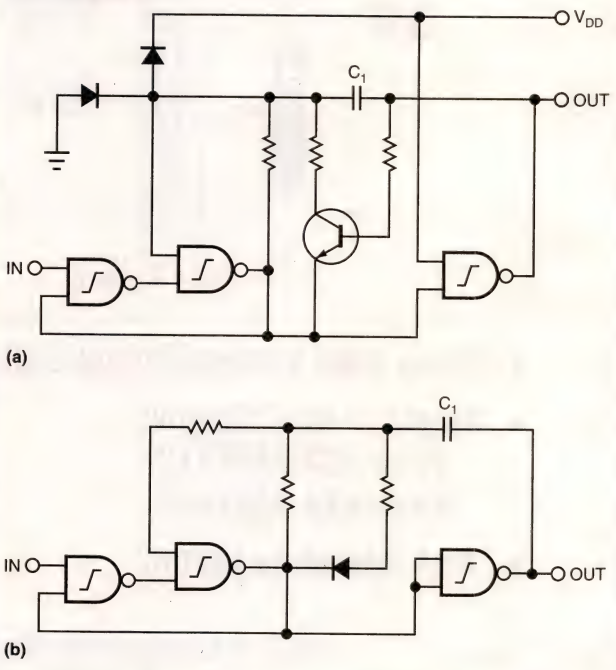
**FIGURE 1**




**The gated Schmitt pulse generators in (a) and (b) respond to a negative input by producing a train of pulses of the same length.**

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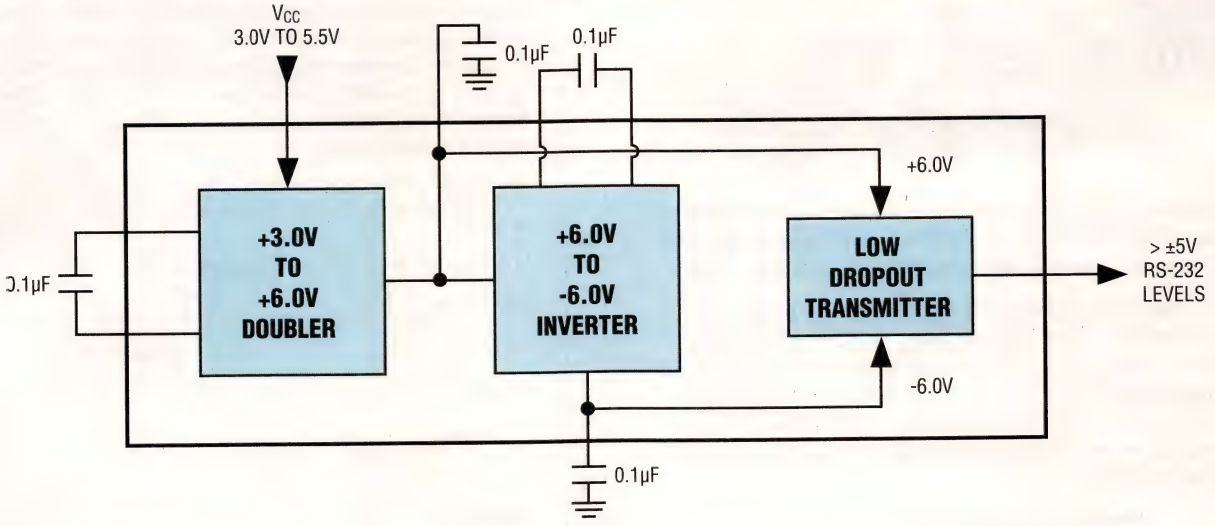


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| FEATURE | MAXIM MAX3241 | VOLTAGE TRIPLERS | RESPECIFIED +5V |
|---|---|---|---|
| ARCHITECTURE | Doubler | Tripler | Doubler |
| NUMBER OF Tx/Rx | 3/5 | 3/5 | 3/5 |
| SUPPLY CURRENT | 1mA | 20mA | 8mA |
| DATA RATE | 120kbps | 20kbps | 20kbps |
| $V_{CC}$ RANGE | 3.0V – 5.5V | 3.0V – 3.6V | 3.0V – 5.5V |
| EXTERNAL CAPS | 4 x 0.1µF | 5 x 1.0µF | 4 x 1.0µF |
| OUTPUT VOLTAGE | > ±5.0V | > ±5.0V | > ±3.7V |
| MOUSE DRIVE | Yes | No | No |


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CIRCLE NO. 107

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LINEAR TECHNOLOGY

DESIGN NOTES

# An Adjustable Video Cable Equalizer Using The LT1256

Design Note 92

Frank Cox

This design note presents a voltage controlled cable equalizer based on the LT1256 video fader. The circuit features ease of adjustment, simplicity and the capability for remote control. The amount of equalization can be adjusted continuously from the maximum allowed by the passive components to none at all. While the example shows video, this high performance equalizer can be used in any system using long runs of coaxial cable or twisted pair to transmit analog signals.

A voltage or current controlled equalizer is essential in systems which automatically set cable compensation. In systems where cable equalization is set manually, a voltage controlled equalizer is still preferred as it does not require routing the signal path to the control. Instead, only a DC control voltage passes from the front panel to the equalizer.

Automatic equalization is possible for properly characterized video cables. Maximum equalization is set to coincide with the maximum length of cable expected; the equalizer is controlled by a servo loop. One method of generating the necessary control voltage is to sample the color burst amplitude and compare this with a reference voltage using a summing integrator. Since the frequency roll-off of the cable is known (and fixed for a given cable) only the amount of equalization needs to be adjusted.

In many applications color video is transmitted down long runs of coaxial or twisted-pair cable. Losses in the cable increase with signal frequency and cable length. The type of cable will determine the rate of high frequency loss. Color information in NTSC video is contained primarily in the high frequency portion of the spectrum. Besides causing a loss of detail in the picture, excessive high frequency loss will make reliable decoding of the composite color signal more difficult or impossible. Most commercial distribution amplifiers have provisions for equalizing the cable losses, but many times these units come at a high cost.

Figure 1 is a complete schematic of the cable equalizer. The LT1256 (U1) is a two input, one output 40MHz current feedback amplifier with a linear control circuit that sets the



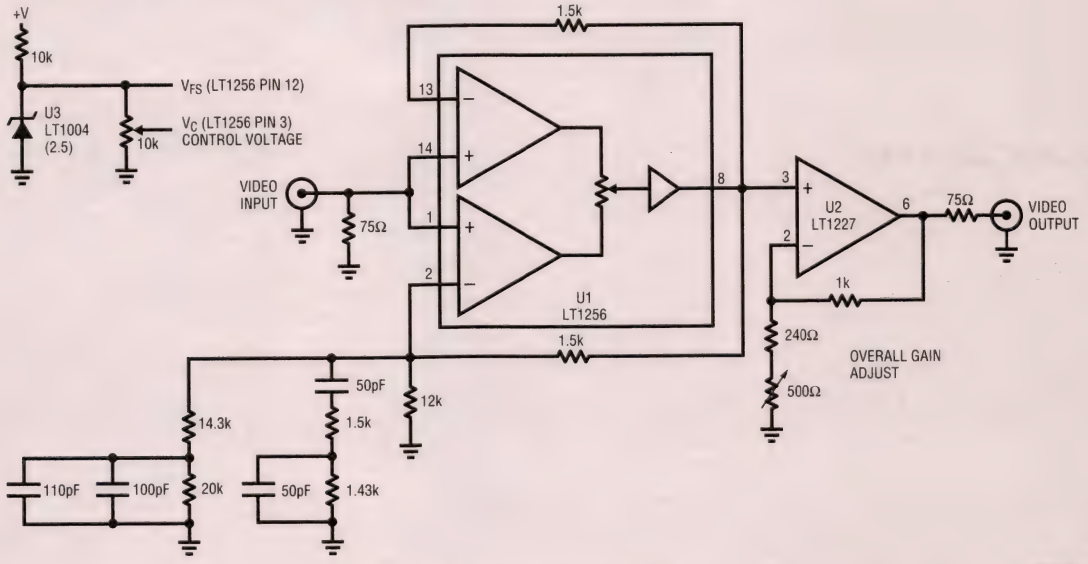


**Figure 1. LT1256 Cable Equalizer**

amount each input contributes to the output. One amplifier (input pins 13 and 14) of the LT1256 is configured as a gain of one with no frequency equalization. The other amplifier (input pins 1 and 2) has frequency equalizing components in parallel with the 12k gain resistor. The equalization components for this demonstration circuit where chosen empirically as no data on the cable was available. As the control voltage is varied the output contains a summation of the two separate input channels; one containing the input video with no compensation and the other with the maximum depth of equalization. By adjusting this mix it is possible to smoothly adjust the equalizer depth. An additional amplifier (U2, LT1227) is used to set the overall gain. Two amplifiers were used here to make setting the gain a single adjustment, but in a production circuit the LT1256 can be configured to have the necessary gain and the whole function can be done with one chip.

In this demonstration a spool of over 250 feet[1] of good quality coax was used to transmit NTSC video. The LT1256 equalizer is placed at the receive end[2] and is adjusted with the use of a test pattern and a video waveform monitor (or oscilloscope). Figure 2 shows the video after transiting the cable and without equalization. Three standard video test signals were used; the mulitburst, the 2T and the 12.5T. The 2T and the 12.5T test signals are sensitive indicators of phase and amplitude distortion in the video signal. The effect of the equalization circuit is shown in Figure 3. The resultant frequency response is flat and the time domain behavior is also excellent. Network analyzer plots of gain vs frequency for various settings of equalizer depth are given in Figure 4.

[1] It should also be noted that the LT1256 can be used to equalize much longer coaxial and twisted-pair cable than the one in this demonstration.

[2] Since the equalizer provides gains at high frequencies there is a possibility of overload if the circuit is placed at the transmit end of the cable rather than the receive end of the cable, especially if there is a need for a great deal of equalization. For example, 2000 feet of Belden 8281 precision video cable will have about 11dB of loss at 5MHz. This requires the driving amp to swing 3.5 times normal if the transmit end is boosted to compensate for the cable.



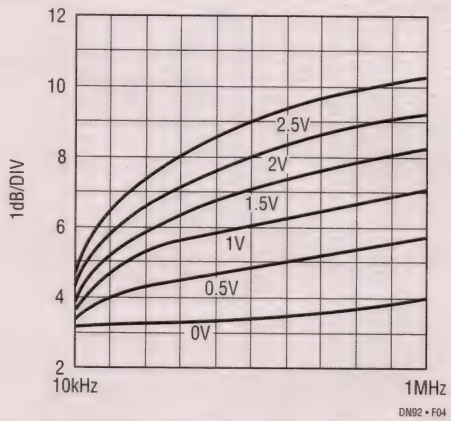


**Figure 4. Frequency Response vs Control Voltage**

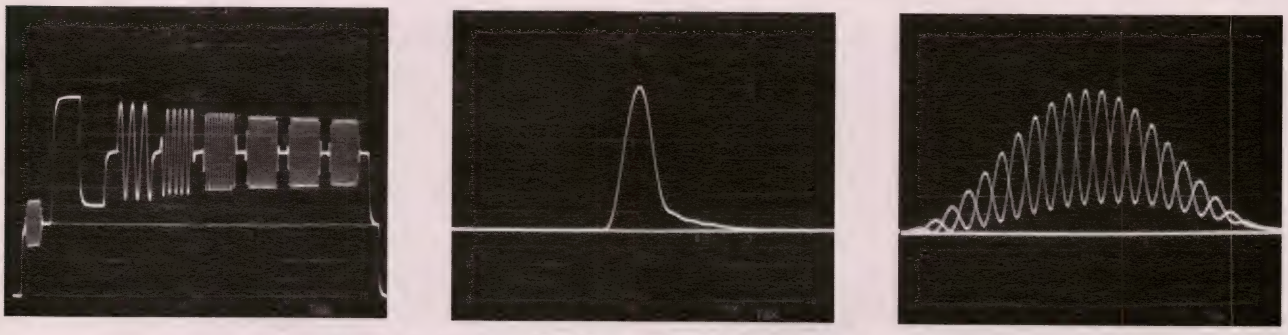

**Figure 2. Multiburst, 2T and 12.5T After 250 Feet of Coax**

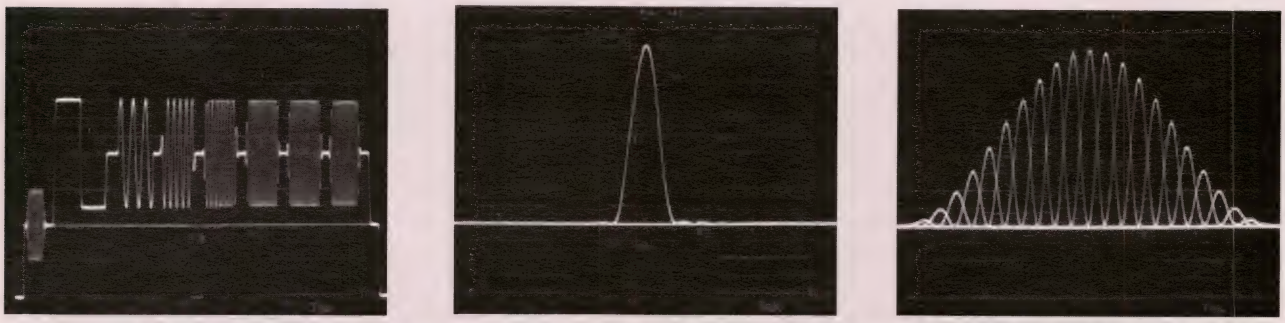

**Figure 3. Multiburst, 2T and 12.5T After 250 Feet of Coax and Equalization, Circuit in Fig. 1**

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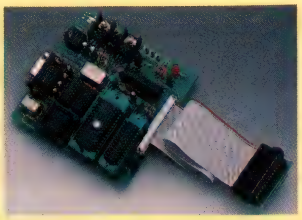

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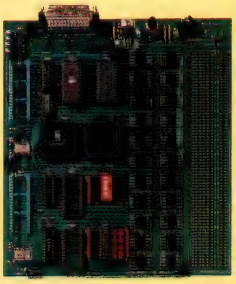


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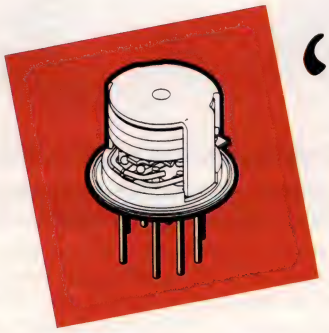
CIRCLE NO. 46

# SWITCHING RF?



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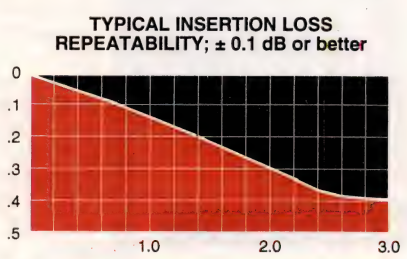


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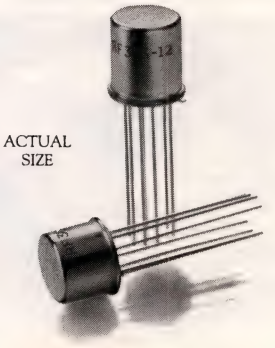


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CIRCLE NO. 157

# Draw workstation graphics into mainstream PCs

RHETT SAUGIER, AT&T MICROELECTRONICS

As PC-display resolutions increase and color depths bloom, higher refresh-rate monitors are becoming more common. A graphics design based on the traditional VGA architecture cannot begin to handle the data-transfer bandwidth required for such high-resolution, "true-color," high-refresh-rate displays.

Equipping a PC with a workstation's graphics architecture can circumvent VGA's inherent performance bottleneck. A workstation typically has a dual-ported, video-RAM (VRAM) frame buffer connected between a high-performance graphics accelerator (usually an ASIC) and a high-speed RAMDAC (a mixed-signal device containing a RAM look-up table, which converts digital pixel codes into analog signals for a monitor). Where a VGA graphics board feeds pixels through an 8-bit port, workstations' graphics accelerators and the RAMDACs have dedicated 32- or 64-bit interfaces. Until recently, however, this workstation-like configuration was too costly for PCs.

Now semiconductor manufacturers offer standard-product graphics controllers and RAMDACs that support a workstation-like architecture while maintaining backwards compatibility with VGA.

This article describes how to design a high-performance, true-color graphics subsystem using such off-the-shelf ICs. It explains how to address architectural, operational, electrical, timing, and cost-performance trade-offs previously unencountered in mainstream graphics-system design.

Even though these standard ICs open up new possibilities for high-end PC and low- to mid-range workstation designers, the devices also raise several new design problems:

- significant changes in graphics-system architecture
- more complex clocking and frame-buffer organization
- increased crosstalk and other noise problems.

The Weitek Power 9100 controller, for example, supports several elements of workstation-graphics design that provide the bandwidth needed for high-performance graphics. **Fig 1** illustrates a typical high-performance graphics-board design for a PC that uses the controller and VRAM.

A high-end graphics controller offloads graphics functions such as line drawing, pattern filling, and bit-block transfers (bitblts) from the system CPU. This offloading leaves the host processor free to run user applications and reduces the amount of graphics data that has to move across the system interface. The controller in **Fig 1** combines a workstation-style, pipelined graphics accelerator with a high-speed, frame-buffer controller. (An optional video coprocessor, the P9130, performs sophisticated color operations in hardware.)

A typical high-end PC demonstrates how this design can give a PC workstation-like graphics performance. The example is a 66-MHz Pentium PC—a Gateway P5-66—having 16 Mbytes of RAM, a 256-kbyte cache, a Western Digital Caviar 2540 hard disk with an IDE controller, and a 2-kbyte disk cache. For this particular PC, the controller's performance exceeds 32 Graphics Winmarks at 1280×1024 pixels, 8

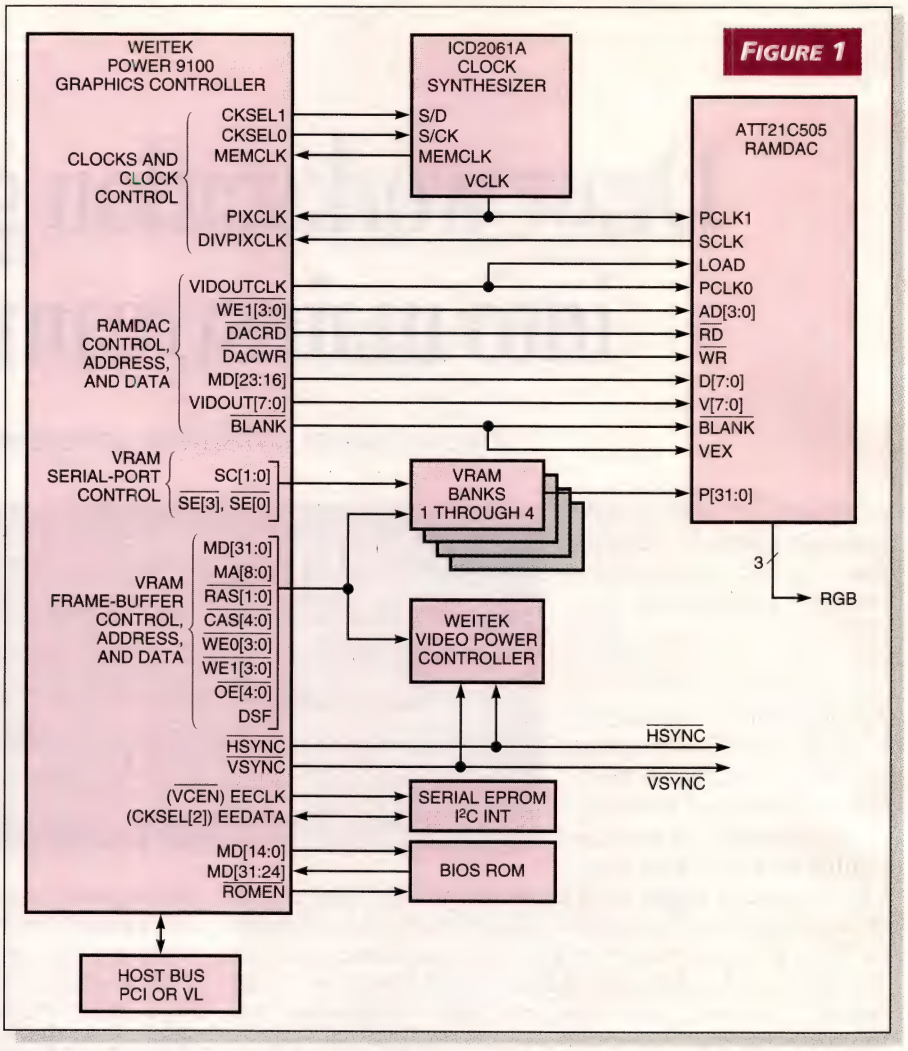
## VGA RUNS OUT OF GAS BEFORE GETTING TO WORKSTATION CLASS

VGA's primary performance limitation is its frame-buffer I/O bandwidth. At 800×600-pixel resolution, a true-color (24-bits/pixel) frame comprises nearly 1.4 Mbytes of data. To refresh the screen at the 75-Hz rate, which the Video Electronics Standards Association (VESA) specifies for flicker-free display, the graphics system must have a data-transfer bandwidth of 150 Mbytes/sec.

Writing 800×600-pixel frames to the frame buffer at the 30-frames/sec standard rate for full-motion video takes an additional 42 Mbytes/sec of bandwidth, not including overhead. High-resolution true-color PC graphics and multimedia can easily require more than 200 Mbytes/sec of data-transfer capacity into and out of a VGA frame buffer.

bits/pixel, 72-Hz refresh rate. In contrast, a VGA-equipped PC, having otherwise similar hardware, attains approximately 4 Graphics Winmarks. *(Ed note: Ziff-Davis's Winbench 4.0 runs on a Weitek Power 9100 Driver video board with 4 Mbytes of VRAM using Weitek's 9100_08.DRV driver running under MS-DOS 6.20 and Windows 3.10.)*

But even with an accelerated controller, true color can place a significant burden on the system bus. Although you can compress typical video data, this kind of data cannot use the drawing capabilities of an intelligent controller. Graphics controllers' built-in drawing abilities speed up only MS-Windows two-dimensional graphics. True-color video (quarter-VGA resolution) at 30 frames/sec requires about 4 Mbyte/sec of real-time data-transfer bandwidth. The data alone consume about half of the ISA bus' maximum theoretical bandwidth and requires twice the ISA's maximum DMA block-transfer rate.




**Similar to a workstation graphics subsystem, a high-end PC graphics board comprises a high-performance graphics controller, a dual-ported video-RAM frame buffer, and a high-performance RAMDAC with a 32-bit pixel port. To support older VGA and Super-VGA (SVGA) applications, the controller has an on-chip SVGA unit tied to an 8-bit SVGA pixel port on the RAMDAC. A separate 32-bit pixel bus gives the RAMDAC a high-bandwidth channel directly to the frame buffer's serial port.**

### Local-bus connection for video

To get around ISA's bottlenecks, you need to put the graphics board on a high-speed local bus. Nearly every new high-end PC graphics controller has a glueless 32-bit local-bus interface to the VESA Local (VL) Bus or the Peripheral Component Interconnect (PCI) bus. The system interface on the controller supports a 44-Mbyte/sec local-bus channel for a 33-MHz bus clock (this peculiar ratio arises because each 32-bit word takes three clock cycles—that is, each clock cycle transfers 4/3 byte). The design example conforms to the PCI specification, although the VL Bus works equally well.

### Backwards compatibility first

To support older VGA and Super-VGA (SVGA) applications, VRAM-based PC graphics controllers have an on-chip SVGA unit tied to an 8-bit SVGA pixel port on the RAMDAC. The SVGA unit is independent of the main graphics engine, and the chip switches between the two graphics units under software control. Although the SVGA unit can support fairly high screen resolutions (up to 1280×1024 pixels in the case of the controller in **Fig 1**) and color depths up to 24 bits/pixel, the 8-bit port is, in general, ill suited for true-color modes.

The 8-bit port comes up short because loading each 16- or 24-bit pixel into the RAMDAC takes multiple clock cycles. At 800×600-pixel resolution (75-Hz refresh), the required pixel rate is about 50 MHz. Because each 24-bit pixel requires three bus cycles for loading through the 8-bit SVGA port, the controller would have to drive the SVGA pixel lines at 150 MHz. The SVGA-port toggle rate for 24-bit/pixel true color climbs to over 200 MHz at 1024×768-pixel resolution.

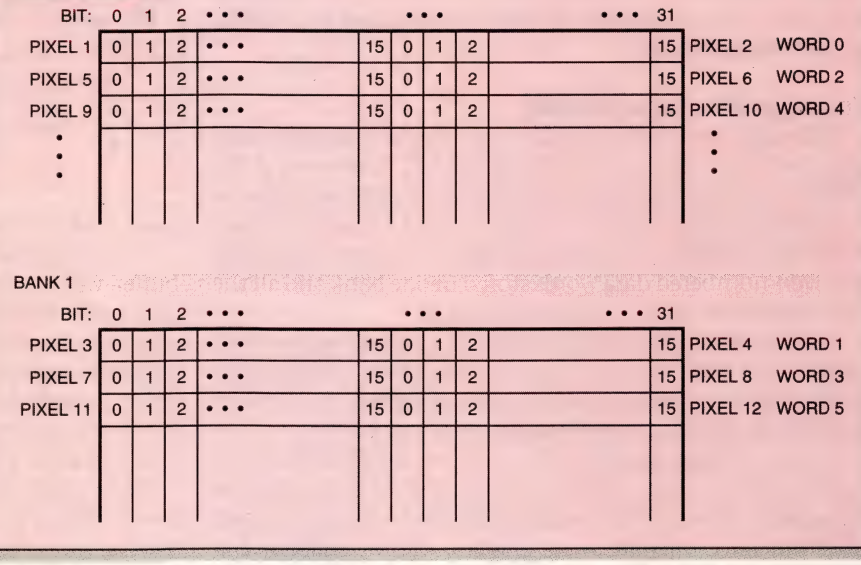
Consequently, the graphics controller almost always bypasses the VGA bottleneck in high-resolution, true-color modes, switching to the wide pixel path linking the RAMDAC directly to the VRAM frame buffer. Today, the typical frame-buffer-to-RAMDAC bus (pixel bus) in VRAM designs is 32 bits wide. A RAMDAC with a 32-bit pixel port, such as the ATT21C505 in this design, can handle a variety of pixel formats. The RAMDAC can accept an entire 24-bit pixel or multiplex two 16-bit pixels, four 8-bit pixels, eight 4-bit pixels, or 32 1-bit (black-and-white) pixels from the frame buffer in just one load cycle. The wide pixel port not only increases the effective display bandwidth but also reduces the VRAM's shift-clock rate required for multiplexed pixels.

As the repository for all data that appear on screen, the frame buffer has to have the I/O bandwidth of the controller

and the RAMDAC combined. You could use either DRAM or VRAM for the frame buffer's memory. A DRAM frame buffer has to divide its I/O bandwidth between frame updates and display accesses—frame updates from the system's processor and display accesses to the monitor. VRAM, on the other hand, taps the memory's full internal bandwidth on two ports at once; VRAM streams pixel data out to the RAMDAC while the controller simultaneously writes new data into the frame buffer.

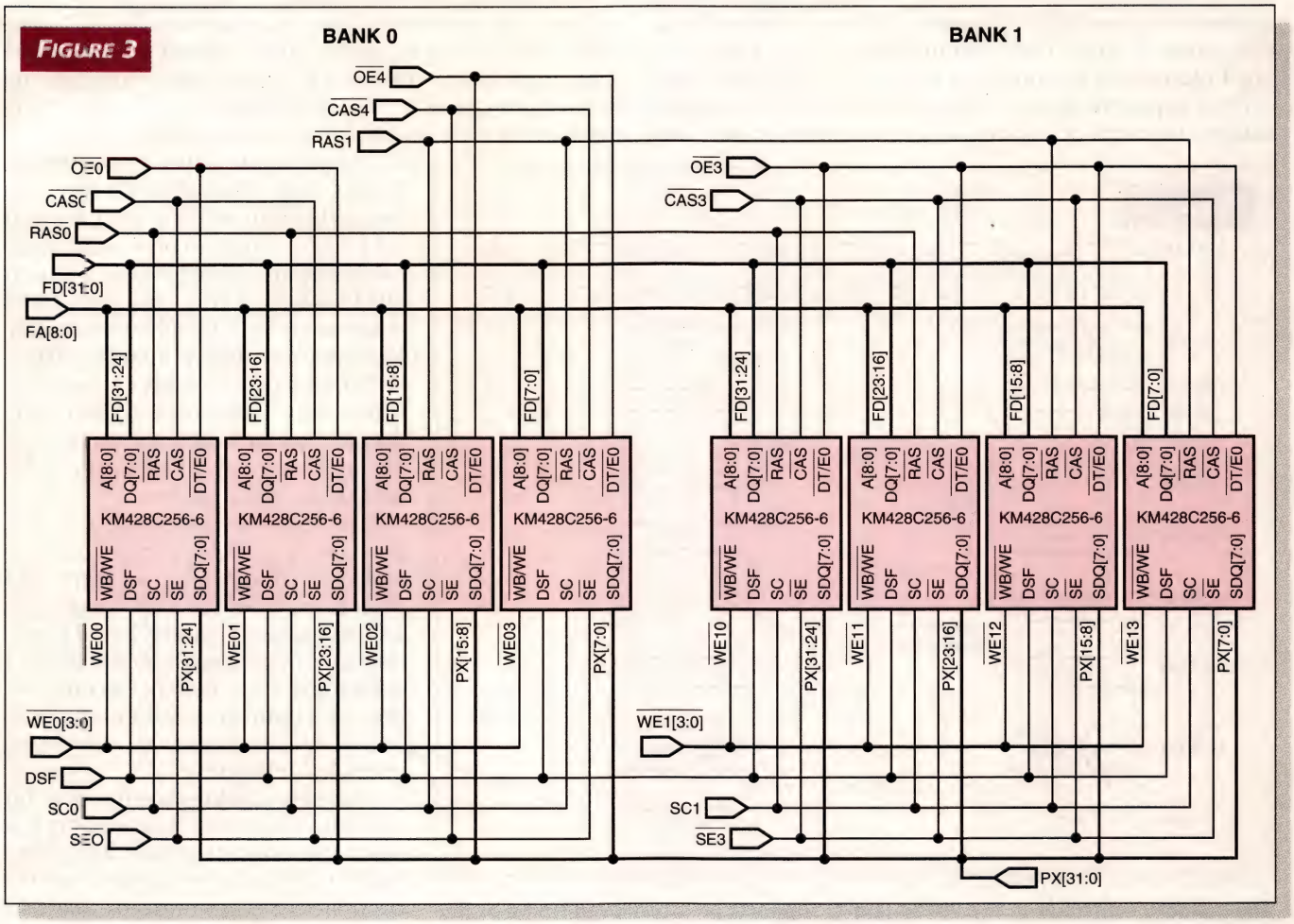
Despite the relatively high cost of VRAM chips, a VRAM design offers some distinct advantages over simply using an extremely wide (64- or 128-bit) DRAM architecture. A wide-DRAM architecture can use relatively slow devices because it passes its entire 64- or 128-bit output to its equally wide RAMDAC in one cycle, achieving a high effective pixel-write rate (writing to a wide-DRAM architecture takes place at

**FIGURE 2**




**An interleaved frame buffer divides into two banks, with all the even-numbered data words stored in one bank and all the odd-numbered words in the other.**

**FIGURE 3**




**A 32-bit-wide, interleaved, 2-Mbyte frame buffer comprises two banks of 60-nsec, 256-kbyte×8-bit VRAM chips. The banks share address and data lines but have separate write-enables, output-enables, column-address strobes, and shift-register control lines.**

modest rates). But, because in a VRAM-based design the high-speed pixel data doesn't have to pass through the controller, the VRAM controller's die can be smaller, dissipate less power, and be housed in a lower-pin-count (ie, smaller and cheaper) package.

### Frame-buffer interleaving

Although an ordinary VRAM frame buffer provides more than twice the I/O bandwidth of DRAM, interleaving the VRAM increases the frame buffer's bandwidth even more—without incurring the cost of higher speed VRAM. An interleaved frame buffer comprises two banks of chips, having all the even-numbered data words stored in one bank and all the odd-numbered words in the other (**Fig 2**).

Because graphics-data accesses are *generally* sequential, interleaving cuts the memory chips' apparent cycle time in half by allowing the controller to read or write a word in one bank while the next memory location is precharging.

For this design example, its 2-Mbyte frame buffer comprises eight 60-nsec, 256-kbyte×8-bit VRAM chips (four in each bank). The two banks share common address and data lines but have separate write enables, output enables, column-address strobes, and shift-register control lines (**Fig 3**).

Advanced controllers support frame-buffer interleaving. When writing to the VRAMs, the controller automatically addresses the two banks alternately, writing even-numbered data words to bank 0 and odd-numbered words to bank 1. **Fig 4** illustrates the controller's write cycle. If the next cycle is not a sequential write to the opposite bank, the controller extends the write operation—which usually takes only one clock cycle—by adding a second "finish write" cycle.

**TABLE 1—BANDWIDTH REQUIREMENTS**

| Bits per pixel | Number of pixels | Required pixel-bus bandwidth (Mbytes/sec) |
|---|---|---|
| 24 | 800×600 | 150 |
| 16 | 1024×768 | 158 |
| 8 | 1600×1280 | <200 |

The controller also has to account for the interleaved frame buffer when prompting the VRAM's shift registers to feed data to the RAMDAC. The controller has to generate the two opposite-phase VRAM shift clocks (SC0 and SC1) and serial output-enable signals (SE[0] and SE[3]) needed to present the data to the RAMDAC's pixel port in the proper order. **Fig 5** shows the timing of the signals that the controller generates to control the VRAM's shift registers.

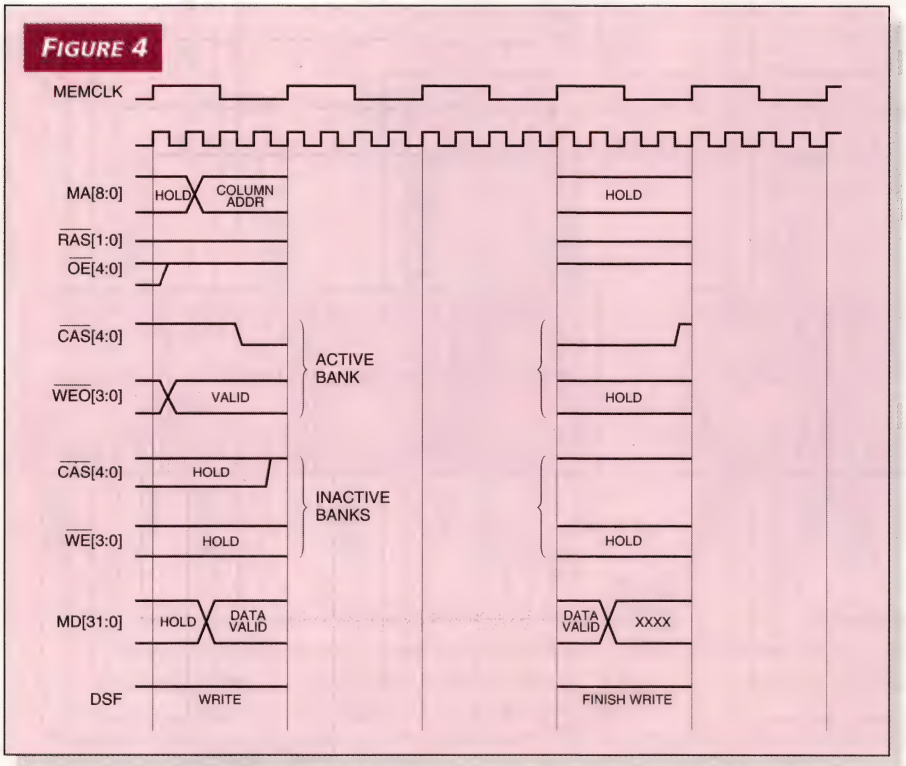
Although interleaving doubles the potential pixel-bus bandwidth for a given memory speed—for this 50-MHz VRAM, from 200 Mbyte/sec to 400 Mbytes/sec—in practice, the frame buffer's size limits the data-transfer rate actually needed in this design. **Table 1** shows the practical bandwidths needed to service a 2-Mbyte frame buffer.

Thus, the only immediate practical benefits of frame-buffer interleaving on the RAMDAC side of the VRAM are that interleaving relaxes VRAM serial-port timing and reduces pin count. In theory, the bandwidth derived from interleaving and a 32-bit pixel port open a migration path to a 4-Mbyte frame buffer. Replacing the 2-Mbit chips (256 kbyte×8 bit) used here with byte-wide 4-Mbit VRAMs (512 kbyte×8 bit), an otherwise identical hardware design would support 1024×768-pixel true color and 16-bit color at 1600×1280-pixel resolution. However, to further increase frame-buffer bandwidth, memory manufacturers favor wider organizations over deeper ones in 4-Mbit VRAM devices. So, unfortunately, 512-kbyte×8-bit VRAMs are not available.

Even without interleaving, the combination of a VRAM's frame buffer, a wide pixel bus, and a separate VGA pixel path makes the video clocking in a VRAM-based PC display board fundamentally more complicated than in a traditional VGA design. Specifically, the video channel uses one of three different clocking scenarios, depending on the color depth.

The first clocking scenario is for VGA. In VGA modes, the controller first reads the pixel data from the frame buffer's random-access port. Then the controller's SVGA unit feeds that data to the RAMDAC's 8-bit VGA pixel port (V[7:0]). The controller operates from

**FIGURE 4**




**The memory controller in the P9100 (Fig 1) supports an interleaved frame buffer by alternately addressing the two banks of VRAM. If the next cycle is not a write to the opposite bank, the controller inserts a "finish write" cycle.**

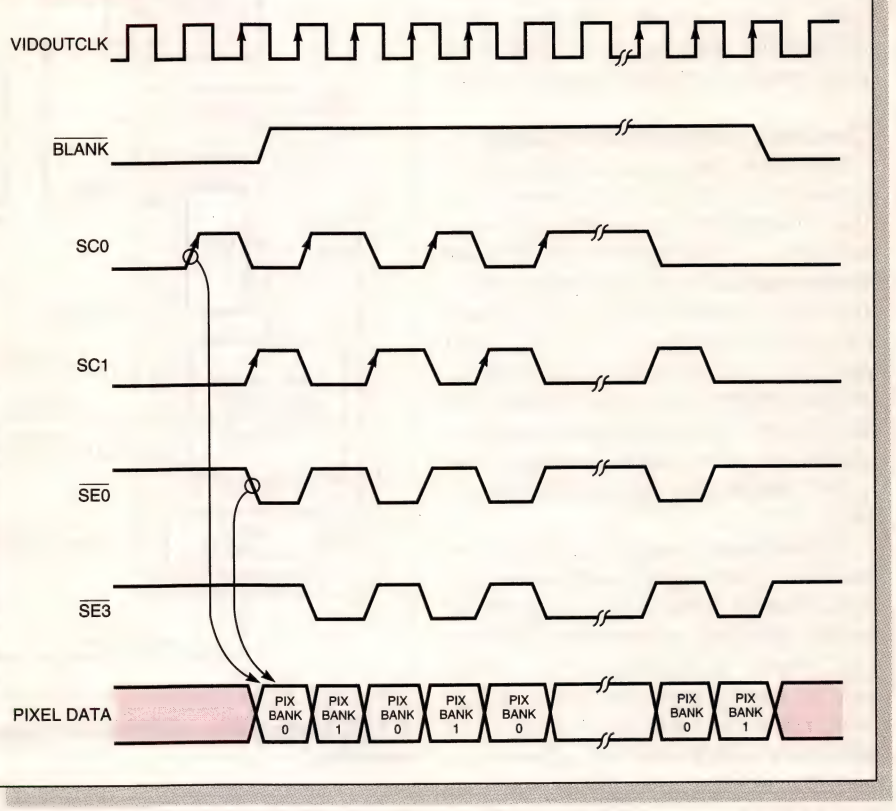
the main pixel clock (VCLK, **Fig 6**) and generates a signal (VIDOUTCLK) that serves as both the pixel clock and the load clock for the RAMDAC. The RAMDAC's LOAD pin controls its input latch. Typically, you tie VIDOUTCLK to both the LOAD and PCLK0 input pins on the RAMDAC, as **Fig 6** shows. Note that in the standard nonmultiplexed (8-bit/pixel) VGA mode, the ATT21C505 RAMDAC derives its pixel clock from the LOAD input, ignoring PCLK0.

Video clocking is more complex in higher performance modes. In these modes, because the display data moves across the main 32-bit pixel bus, the VRAM's serial-port operation must synchronize with the RAMDAC. The controller has to maintain the proper phase relationship between the memory-control signals (SC and SE) and the load clock so that the RAMDAC's pixel port latches each pixel only when the data are valid (**Fig 5**).

Typically, 32-bit RAMDACs for VRAM-based designs have an on-chip clock divider. The ATT21C505 in this design automatically generates a shift clock corresponding to the color/multiplexing mode, which the device's configuration register selects. To accommodate all three clocking scenarios requisite in this type of graphics-board design, both the RAMDAC and the controller have dual pixel-clock inputs selected via the devices' respective configuration registers.

In the simplest case—the nonmultiplexed, 24- or 16-bit/pixel modes—the controller can drive the video clocking directly. In this design, however, the controller takes the main pixel clock from the clock synthesizer and generates the shift clocks (SC[0:1]), serial enables (SE[0] and SE[3]), and

**FIGURE 5**




**On the serial-output side of the frame buffer, the controller accounts for the interleaved data by generating two opposite-phase VRAM shift clocks (SC0 and SC1) and serial output-enable signals (SE0 and SE3).**

## GRAPHIC DESIGN: ONE BOTTLENECK AFTER ANOTHER

The title "primary performance-limiting factor" in PC graphics just migrates from one bottleneck to another.

The problem used to be the system bus; now local buses provide plenty of host-interface bandwidth. A few years ago, controllers couldn't move pixels fast enough. Now high-speed intelligent controllers with wide internal and I/O buses are available. The 8-bit VGA pixel port limited the color depth that RAMDACs could display at high resolution; currently, pixel-port widths are moving to 32 and 64 bits—and beyond.

Today, the problem is memory. The disagreeable trade-off between frame-buffer size and cost stands in the way of higher performance PC graphics. For example, the next step up from this design requires increasing the frame-buffer size to 4 Mbytes—large enough for 24-bit/pixel true color at 1024×768-pixel resolution (1280×1024 with pixel packing). This article's controller and RAMDAC can support a 4-Mbyte design. But, unfortunately, a 4-Mbyte version of this particular design would require 512-kbyte×8-bit VRAMs.

The new VRAM chips actually in the offing—256-kbyte×16-bit VRAMs with their serial ports organized into a 64-bit pixel bus—differ significantly from the VRAMs in design. However, such VRAMs could use the controller from this design along with a 64-bit RAMDAC such as the ATT20C311 or ATT20C511.

The real barrier keeping higher resolution, high-performance, true-color graphics from the mainstream PC market is the price of VRAM. At about $45 per megabyte, the cost of 4 Mbytes of VRAM exceeds (more than two times) the cost of a controller and an ATT21C505 or ATT20C311/511 RAMDAC combined. For the time being, a high-performance graphics board capable of 24-bit graphics at 1024×768 pixels and above may be more expensive than the high-volume PC market can bear.

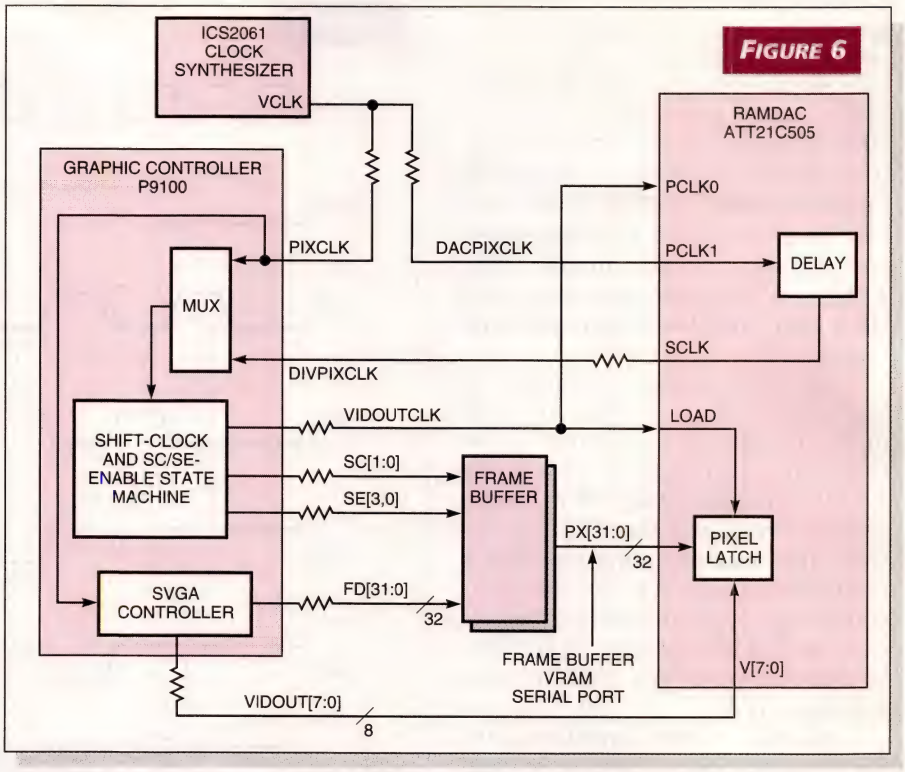
## HIGH-PERFORMANCE PC GRAPHICS

the load clock (VIDOUTCLK). The design doesn't need a dedicated RAMDAC pixel clock because the ATT21C505 uses the load clock as its pixel clock in nonmultiplexed modes.

### Clocking multiple-pixel loads

Whenever you pack multiple pixels into each 32-bit RAMDAC load—ie, in the 2:1 multiplexed, 16-bit/pixel mode and the 4:1 multiplexed, 8-bit/pixel mode—the load rate is obviously only a fraction of the DACPIXCLK'S pixel-clock rate. In these cases, you need divided clocks to drive the VRAM's shift registers and the RAMDAC's LOAD pin. The RAMDAC also needs an undivided pixel clock for timing the video output (but the controller does not).

The solution to supplying all of the necessary clock signals and keeping the frame-buffer serial port synchronized to the RAMDAC is to make the RAMDAC master of the display-data clocking. In multiplexed modes, the RAMDAC takes the main pixel clock from the clock synthesizer and generates a master shift-clock signal (SCLK). The controller uses this master shift-clock signal to synchronize both the VRAM's shift clocks and its serial enables to the RAMDAC's timing.

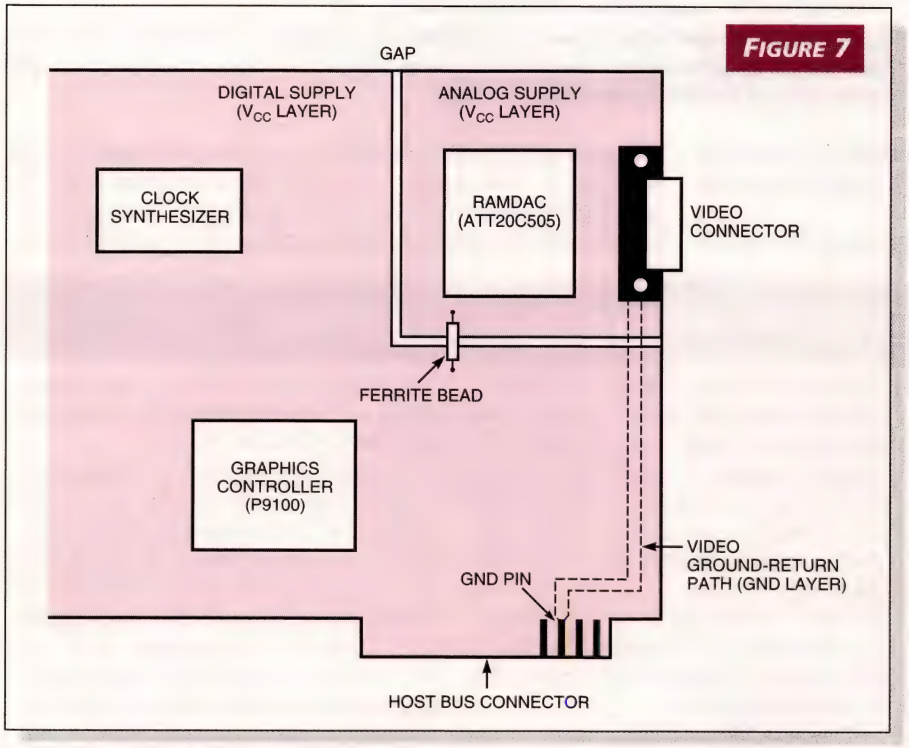



**A VGA-compatible VRAM-based graphics board must support three clocking scenarios.**

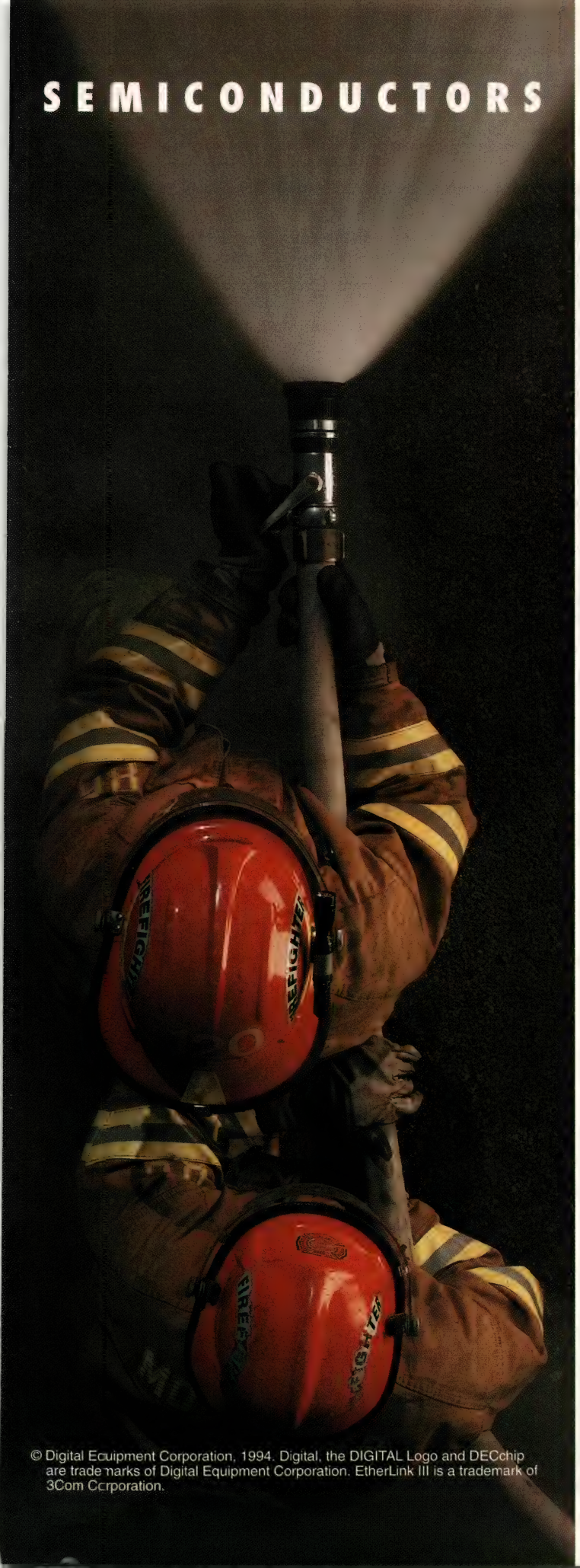
The frequency of SCLK depends on the color mode. In the 2:1 multiplexed, 16-bit/pixel mode, only one data load occurs for every two pixel clocks; therefore, SCLK runs at one-half the pixel-clock frequency. At 8 bits/pixel (4:1 multiplexed), SCLK runs at one-quarter the pixel-clock frequency.

The hardware has to generate the proper sync and blank timing signals for each mode's monitor. The controller uses the divided pixel clock to generate the sync and blank video-timing signals and also to control reloading the VRAM's shift registers.

In this design, the controller's built-in clock divider generates an internal index clock CRTC_CLK (not shown in **Fig 6**) from the RAMDAC's SCLK signal. The host system must program the controller's video-control registers with the appropriate sync and blank timing as a function of CRTC_CLK. The driver software must account for the fact that each CRTC_CLK represents multiple pixels




**To prevent digital noise from reaching the analog signals, separate the power plane into digital and analog areas connected by a ferrite that filters out high-frequency currents. A separate video ground-return trace, running directly from the video connector to the ground of the host connector, prevents the analog-video return current from interacting with components on the board.**



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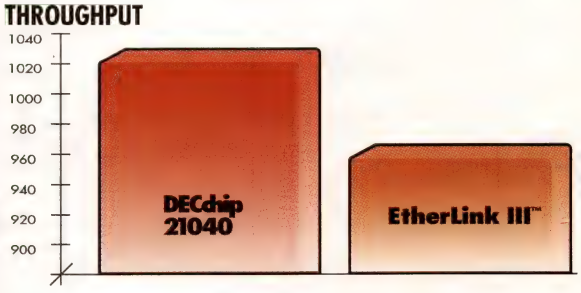


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in multiplexed color modes. However, you do not need to adjust for pixel multiplexing when configuring the controller's shift-register reload parameters. As long as the controller's internal clock is not divided down from the input (SCLK), each clock cycle corresponds to a full 32-bit data word in any of the multiplex modes.

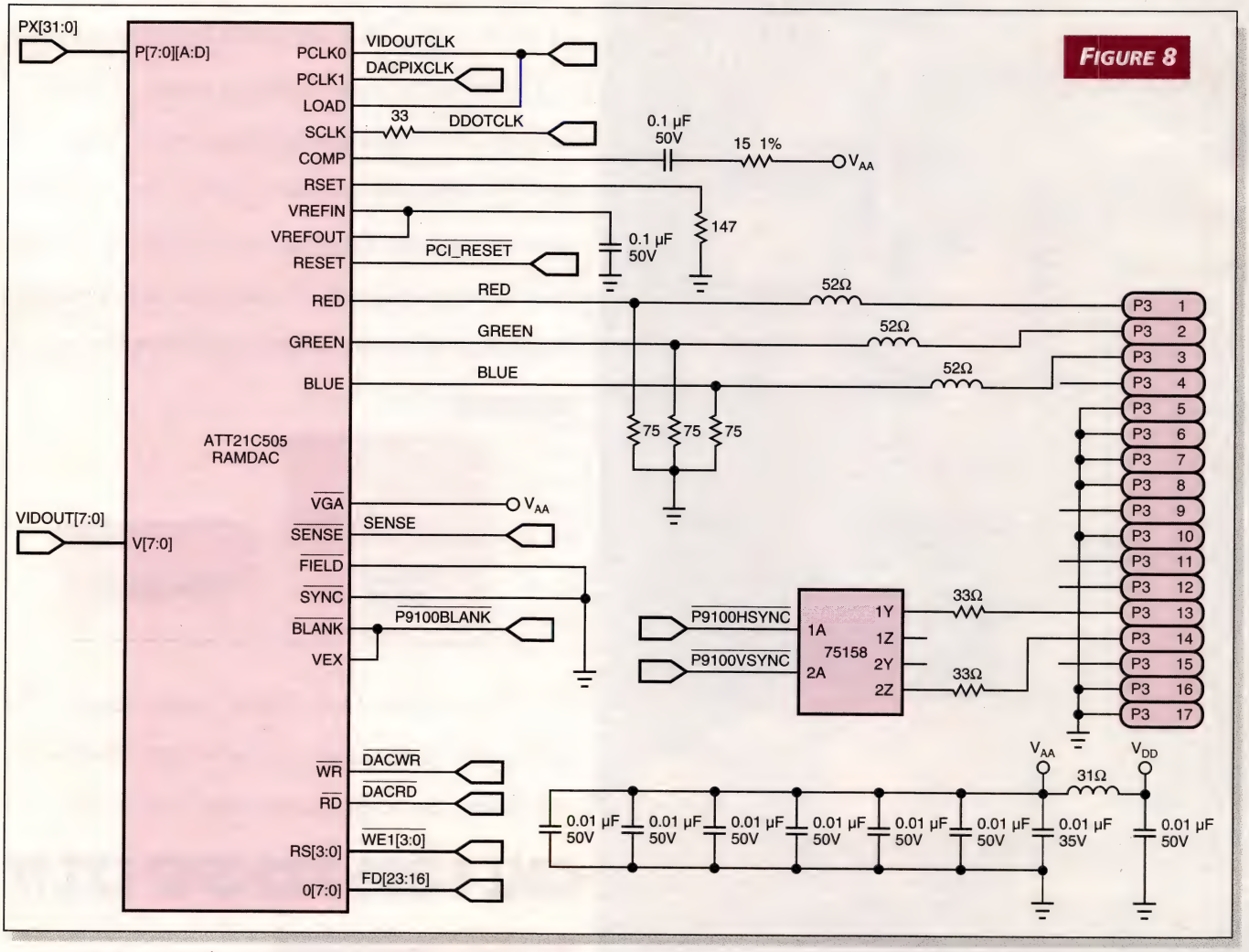
Multiple-pixel transfers make supporting resolutions greater than 1280×1024 possible, even though the video rates required are well above 100 MHz. Although multiplexing reduces the toggle rates on the pixel lines and most clock lines, the RAMDAC still has to clock the pixels internally at the full video rate: 170 MHz for 1600×1280 pixels (60-Hz refresh) and 135 MHz for 1280×1024 pixels (at 72 Hz). Transmission-line effects make driving a 110-MHz, TTL-pixel clock from the clock synthesizer across a copper trace to the RAMDAC difficult.

Even if you were to design a transmission line to carry the full-speed pixel clock, the extreme edge rates (2000 to 4000 V/μsec) would generate considerable EMI. Consequently, the RAMDAC must double a lower frequency input signal to generate the video pixel clock internally. Suppliers of high-performance RAMDACs integrate a clock doubler onto their RAMDAC chips. The clock doubler can generate the 1280×1024-pixel video rate of 135 MHz, for example, from a 67.5-MHz input clock.

High-performance RAMDACs derive the proper SCLK and LOAD clock frequencies from their internal pixel-clock rate, not the clock rate on their input pin; that is, for 1600×1280-pixel resolution (170-MHz operation) at 8 bits/pixel (4:1 multiplexing), PCLK1 would be 85 MHz, and LOAD and SCLK would run at 42.5 MHz—or one-fourth the internal pixel-clock rate.

Some RAMDACs double the clock using the falling edge of the input signal. This scheme works fine as long as the input signal exhibits a stable 50% duty cycle. But if the duty cycle deviates from 50%, the deviation shows up on the CRT as alternating columns of wider and narrower pixels. The RAMDAC here has a PLL clock doubler, which obviates an accurate 50% duty cycle.

*Text continued on pg 142*




**For this high-performance graphics board, use one 0.1-μF capacitor for every two pins and place an additional 0.01-μF capacitor in parallel with each 0.1-μF component to shunt the high-frequency harmonics to ground. A 10-μF capacitor filters out the lower frequencies. Load resistors match the outputs to the impedance of the termination (a 75Ω monitor).**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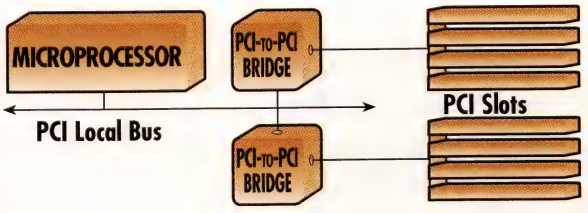


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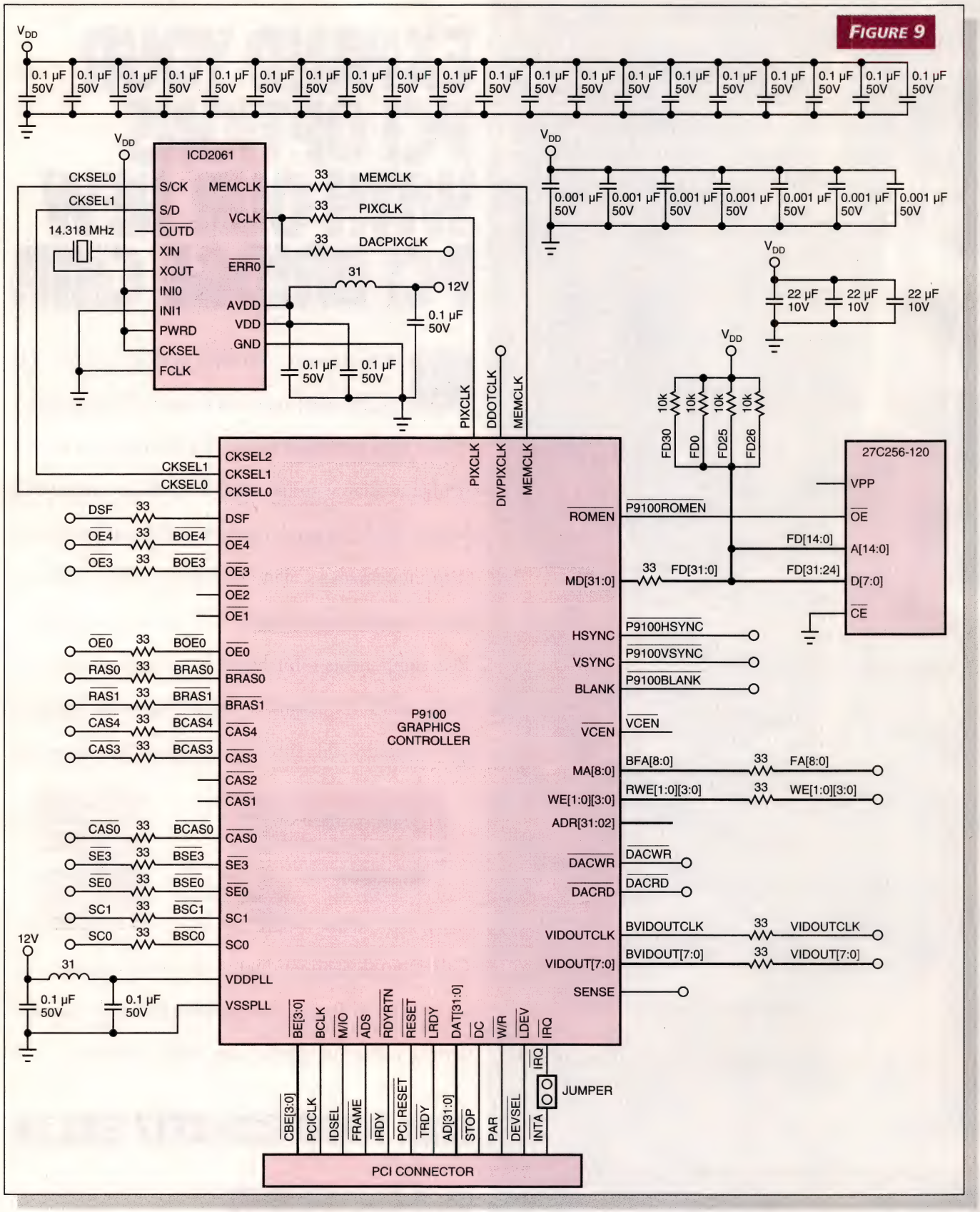


**A robust network of capacitors decouples the controller's $V_{CC}$ pins. To prevent high-slew-rate edges from feeding through to the DAC outputs, slow all address, data, and control lines from the P9100 as well as all clock lines, with 33Ω resistors.**

## HIGH-PERFORMANCE PC GRAPHICS

Even though a PLL clock doubler ensures that all the pixels are always the same width, you must take certain precautions when switching into and out of the clock-doubled modes.

- The BIOS software must provide a 10-μsec delay for the ATT21C505's PLL to lock into the new frequency before updating the palette or feeding pixels to the RAMDAC.
- In addition, the BIOS should copy the contents of the RAMDAC's cursor and color-palette RAM into system memory and shut down the internal RAM to ensure that data are not corrupted by the clock signal, which may be noisy until the PLL locks.
- After switching to the new mode and waiting for the internal clock to settle, the controller can write the cursor and palette data back into the RAMDAC.

The host computer can easily accomplish this sequence of operations during one vertical-blank period—much less time than needed to resynchronize the monitor.

Although the RAMDAC clock doubler helps moderate EMI problems that occur with high-performance graphics design, take additional steps to ensure a clean video signal and FCC EMI compliance. Noise control begins with the pc board. A four-layer board with separate power and ground planes yields quieter signals and supplies (as well as less spectral content in emitted frequency bands) than a one- or two-layer board. Route signals on the board's outside layers.

Separate the power plane into digital and analog areas, connected by a ferrite bead (**Fig 7**). The ferrite bead filters out high-frequency currents and should exhibit resistance starting at a frequency higher than the maximum signal frequency on the board but lower than the second harmonic of that frequency. A Fair-Rite 2743001111, a Ferroxcube VK20019-4B, or a Philips 431202036690 ferrite, each of which provides a resistance of approximately 75Ω at 100 MHz, are appropriate for this design.

In lower speed designs with pixel clocks of 110 MHz or less, two 0.1-μF capacitors (one for every three pins) decouple the RAMDAC's $V_{CC}$ pins. For this high-performance graphics board, however, use one 0.1-μF capacitor for every two pins (a total of three) and place an additional 0.01-μF capacitor in parallel with each 0.1-μF component to shunt the high-frequency harmonics to ground (**Fig 8**). A 10-μF capacitor filters out the lower frequencies. (Use chip capacitors because of their significantly lower lead inductance.)

A comparably robust network of capacitors must decouple the RAMDAC's $V_{CC}$ pins. To ensure clean clock signals free of high-frequency noise components, decouple the clock synthesizer's $V_{DD}$ pins and the RAMDAC's PLL's supply pins with pi filters. Filter the RAMDAC's COMP pin with a series 15Ω resistor to smooth out noise (the COMP pin allows compensating for the internal parasitic capacitance of the RAMDAC's FETs with an external 0.1-μF capacitor).

The edge rates on the pixel bus, clock lines, and sync and blank lines can play havoc with any signals routed nearby. Keep these lines away from the RGB analog outputs—and each other. All high-speed lines, both analog and digital, should be as short as possible. To this end, locate the RAMDAC adjacent to the video connector (between the video connector and the host-interface connector) to minimize circuitry between the RAMDAC and the board's power-supply pins.

You can place the RAMDAC over the analog power plane somewhere close to the digital/analog separation; or, place it astride the digital/analog separation so that the pixel inputs are over the digital-supply plane. Placing the RAMDAC over the digital/analog separation reduces coupling into the analog plane.

The main consideration in routing the clock signals is preventing noise from coupling onto the pixel lines. Keep clock-signal traces as short as possible and do not run them parallel to the pixel lines or any other high-speed signals. Putting the clock and pixel lines on different planes is best, but they can be on the same plane if you shield them with a ground trace on each side. Route no high-speed signal under the RAMDAC itself.

Because this design has so many digital signals, high-slew-rate edges may feed noise to the DAC outputs despite all of the precautions listed previously. The only solution is to smooth the fastest edges using series resistors. Slow all address, data, and control lines from the controller (including the VGA-pixel lines) as well as all clock lines with 33Ω resistors located very close to the controller or clock generator (**Fig 8**).

### Approaching an ideal transmission line

Ideally, the analog RGB video signals would run down a perfectly matched 75Ω coax transmission line the entire way from the DAC's outputs to the monitor. However, you can avoid the expense and inconvenience of this ideal solution. Load resistors match the outputs to the impedance of the termination (a 75Ω monitor). Place these load resistors as close as possible to the DAC's output pins. You can add series ferrite beads (52Ω) to the analog video signal to filter out any high-frequency signals coupled onto the DAC's outputs or reflected from the monitor. In addition, a separate video ground-return trace on the ground layer of the pc board, running directly to the ground of the host connector, prevents the analog video return current from interacting with components on the board. EDN

## Acknowledgment

*Thanks to Robert Embry, who has seven years technical sales experience with Weitek, for reviewing this article and contributing technical information.*

## Author's biography

*Rhett Saugier is graphics applications manager for AT&T Microelectronics' Application Specific Standard Products Division in Allentown, PA. He holds a BSEE from San Diego State University and has 10 years' experience as a marketing and applications engineer for various analog-IC vendors, including Texas Instruments and Brooktree. Saugier has been with AT&T Microelectronics since 1990.*


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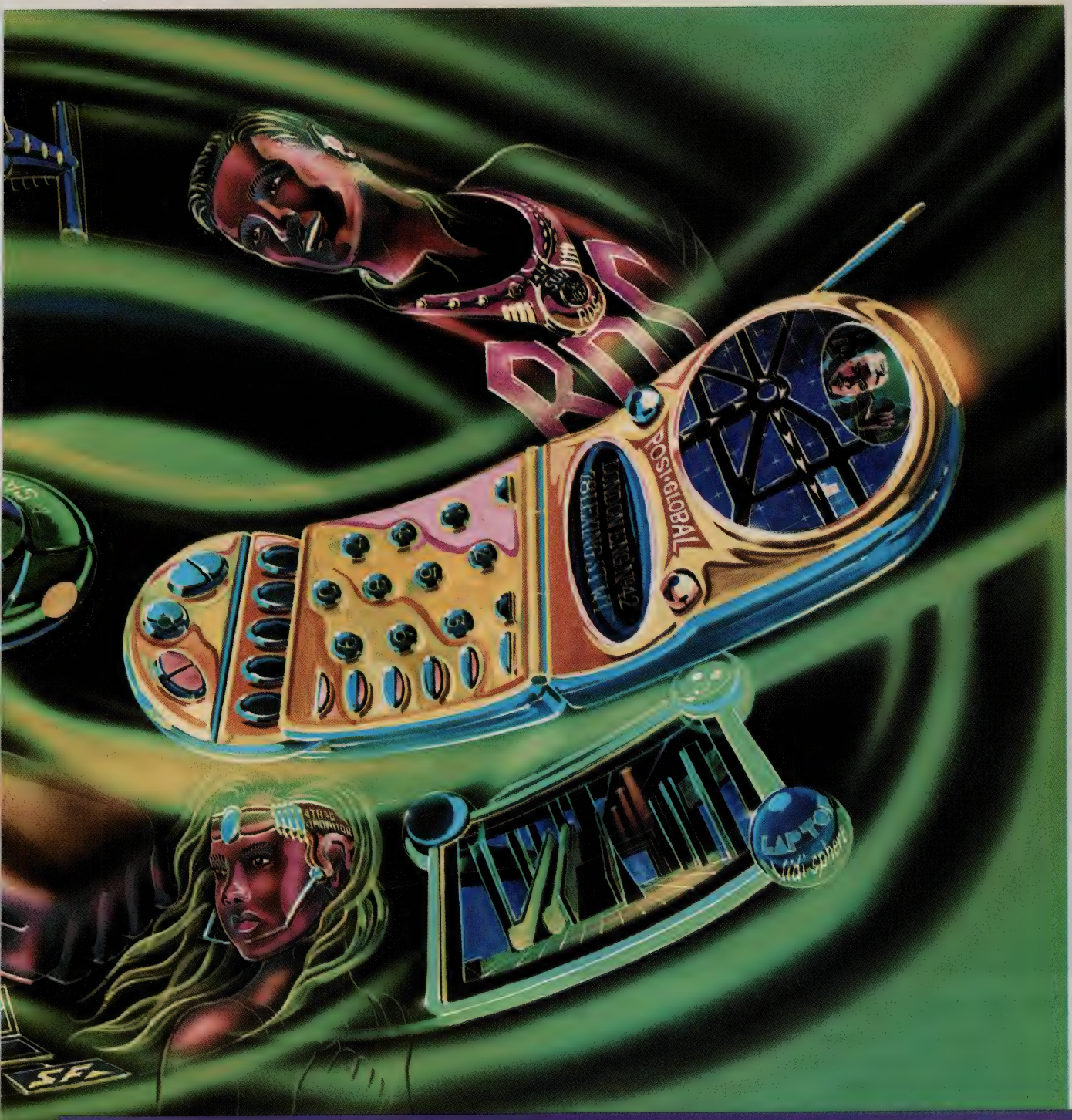


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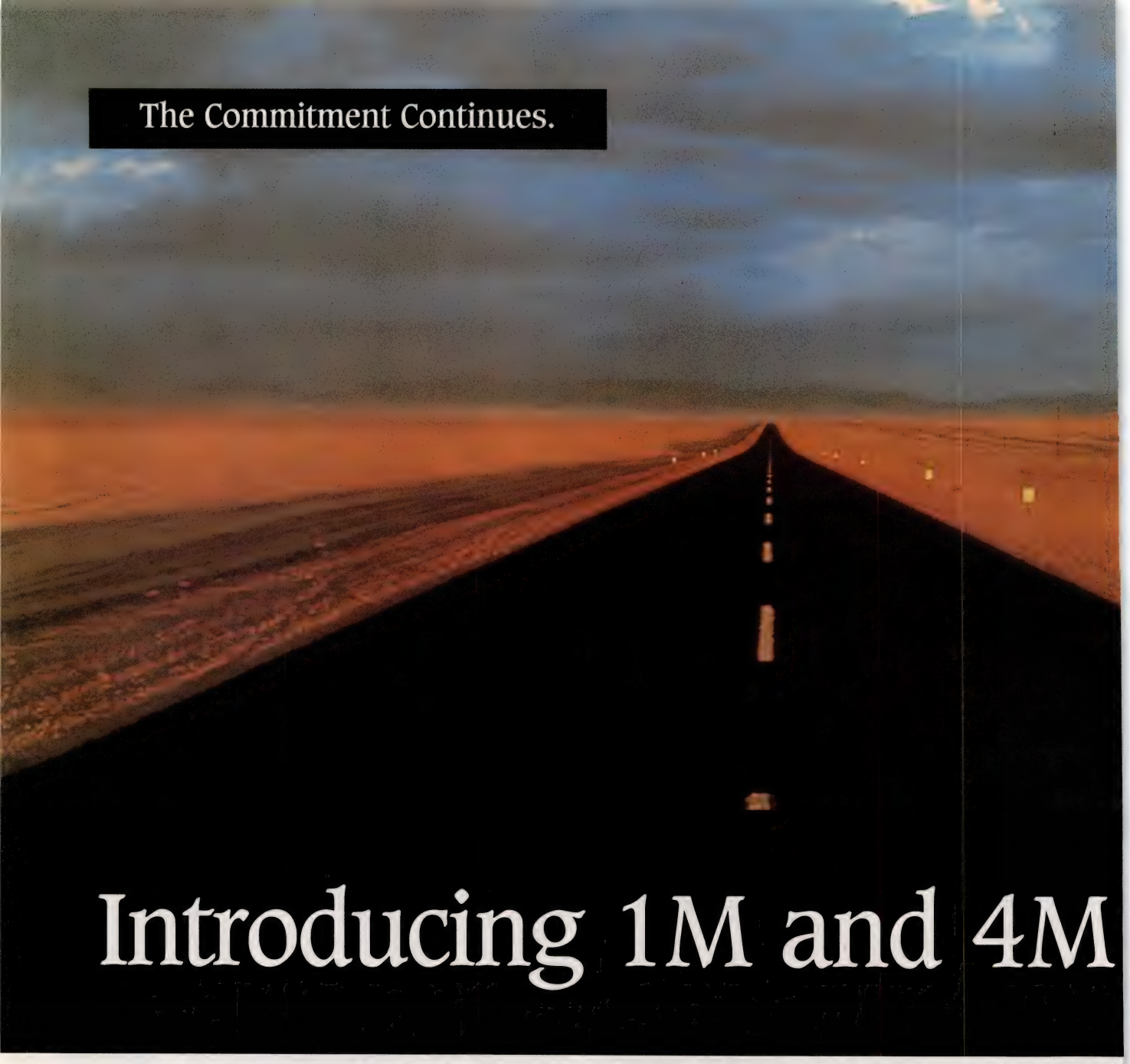


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|---|---|---|---|---|---|---|---|---|
| | | | | | Typ | Max | Typ | Max |
| HY6264A | 8K x 8 | Now | PDIP, SOIC | 70 to 100 | 1µA | 10µA | 1µA | 5µA |
| HY62256B | 32K x 8 | Now | PDIP, SOIC, TSOP | 55 to 100 | 1µA | 20µA | 0.5µA | 10µA |
| HY628100A | 128K x 8 | Jan '95 | PDIP, SOIC, TSOP | 55 to 100 | 1µA | 10µA | 1µA | 5µA |
| HY628400 | 512K x 8 | Q2 '95 | PDIP, SOIC, TSOP | 55 to 100 | 1µA | 30µA | 1µA | 15µA |

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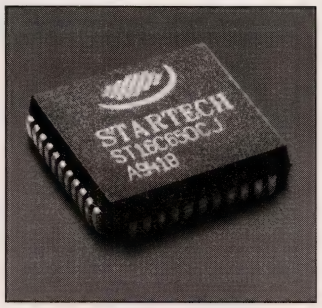
**Spread-spectrum chip set targets 900-MHz cordless phones.** The AT48801 8-bit μC and AT48802 DSP form a chip set for implementing direct-sequence spread-spectrum (DSSS) wireless communication systems. According to the company, the DSSS technology improves the range of cordless phones by a factor of up to 10, compared with conventional cordless phones. The chip set costs $24 (1000). **Atmel Corp**, San Jose, CA. (408) 441-0311.
**Circle No. 320**

**PWM controller has wide input-voltage range.** The TL5001C PWM controller operates with the back-lit power supply of LCD drivers and flat-panel displays in consumer and portable-computer electronics. The device accepts an input voltage from 3.6 to 40V and operates at frequencies from 40 to 400 kHz. The device requires a 1.4-mA supply current and has internal short-circuit protection and 100% dead-time control. The IC is available in 8-pin DIP and surface-mount packages. $0.71 (1000). **Texas Instruments Inc**, Denver, CO. (800) 477-8924, ext 4500. **Circle No. 321**

**Clock-generator chip automatically eliminates clock skew in Pentium and PowerPC systems.** The ML6510 removes skew without extra wires or feedback paths. The device measures how long it takes for each reflection to return from the end of the trace. The circuit adjusts a voltage-controlled delay that sends the clock earlier in proportion to the length of the trace. All eight clock signals are independently controlled. $24.25 (1000) for 10- to 130-MHz systems and $18.60 (1000) for 10- to 80-MHz systems. **Micro Linear Corp**, San Jose, CA. (408) 433-5200. **Circle No. 322**



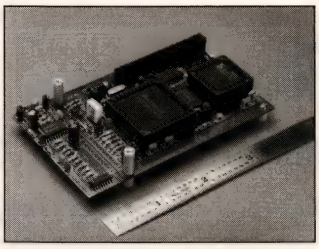

**Asynchronous communication element provides modem control with 28.8-kbps data rate.** The ST16C650 has a 32-byte FIFO buffer and a sleep mode that automatically powers down the chip when no data is transmitting. The IC draws 500 μA during standby and 1.3 mA during full operation. From $5.40 (1000) in a 44-pin PLCC. **Startech Semiconductor Inc**, Sunnyvale, CA. (408) 745-0801.
**Circle No. 323**

**High-voltage dual op amp provides 2A current output.** The OPA2544 dual op amp operates from ±10 to ±35V supplies and has a slew rate of 8 V/μsec. The device drives electromechanical devices, including motors, valves, and speakers, and programmable power supplies and automatic test equipment. Other features include a 50-pA input-bias current, internal current limit, and internal thermal shutdown protection. The device comes in a TO-3 package and costs $22.25 (100). **Burr-Brown Corp**, Tucson, AZ. (602) 746-1111.
**Circle No. 324**

**PCMCIA power switch in narrow-body SO-16 package.** The Si9712 performs the power switching between a computer's PCMCIA slot and the PCMCIA card. The switch has a maximum on-resistance of 111 mΩ for 5V and 85 mΩ for 3.3V. The power-switch IC provides a 2-msec power-up ramp time to avoid current spikes in the power supply during turn-on. $2.50 (100,000). **Siliconix**, Santa Clara, CA. (800) 554-5565, ext 41. **Circle No. 325**

**Package provides battery-backed SRAM on surface-mount boards.** The MK48Z18 8k×8 nonvolatile SRAM, $7.82 (10,000), and the M48T18 nonvolatile SRAM with integrated real-time clock, $12.07 (10,000), use the Snaphat surface-mount package. The Snaphat package houses the battery in a separate packages that snaps in place after soldering. The separate housing avoids exposing the battery to high soldering temperatures, which adversely affect lithium batteries. The IC with battery can maintain data and keep the clock running for at least 10 years without system power. Prices include the battery. **SGS-Thomson Microelectronics**, Lincoln, MA. (617) 259-0300. **Circle No. 326**

**Solid-state relay for telecommunications provides switching and ringing detection.** The LH1529 combines a solid-state relay with an autopolarity optocoupler in an eight-lead package. The device suits applications that combine the switch-hook function, ring detection, and other switching and isolation functions, such as pulse dialing and current sensing. The switch is rated at 350V and 120 mA with a typical 20Ω on-resistance and features integral current limiting, protecting both the relay and other circuitry from current surges caused by lightning. The optocoupler provides a minimum of 3750V rms input-to-output isolation. $2.96 (10,000). **AT&T Microelectronics**, Allentown, PA. (800) 372-2447. **Circle No. 327**



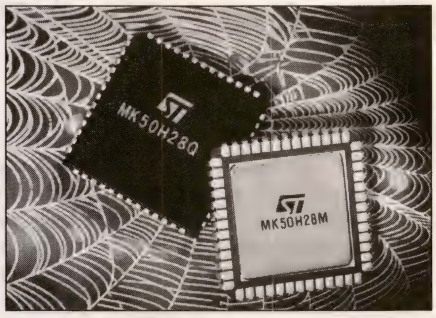
**Three-chip set adds voice recognition to μP systems.** The TrueWord voice-recognition-module chip set uses a language-independent voice-recognition algorithm that has 98% recognition accuracy on a user-determined vocabulary of up to 100 words. Typical response time is 0.5 sec. $20 (1000). **Vocal Inc**, Palo Alto, CA. (415) 323-5613. **Circle No. 328**

**T1/E1 line-interface unit provides short-circuit transmitter protection.** The CS61577 has software-selectable output-signal levels, internal pulse-width control, improved loss-of-signal handling, and a 34% lower power consumption than the company's CS61574. The IC also has 50-mA rms short-circuit current limiting to provide a failure-tolerant design. The chip meets the British OFTEL OTR-001 circuit-protection requirement without external circuitry. $14 (1000). **Crystal Semiconductor Corp**, Austin, TX. (512) 422-7555. **Circle No. 329**

**ATM segmentation and reassembly controller has PCI local-bus interface.** The IDT77201 segmentation and reassembly controller interfaces directly with a PCI local bus and provides continuous full-duplex service at 155 Mbps. The SAR controller supports asynchronous-transfer-mode (ATM) adaptation layer types 3/4 and 5 for variable- and constant-bit-rate traffic-management models. For transmission, the device segments data into 53-byte ATM cells and performs traffic shaping. For data received from a network via a physical interface/transceiver device, the controller reassembles cells into complete protocol data units. $80 (1000). **Integrated Device Technology Inc**, Santa Clara, CA. (800) 345-7015. **Circle No. 330**

**IC temperature sensor in SOT-23 package.** The LM45 temperature sensor comes in a SOT-23 surface-mount package. The compact, low-thermal-mass package suits the device to a variety of temperature-sensing applications. The sensor has a 10-mV/°C scale factor and a ±0.8°C nonlinearity over the –20 to +100°C range. Calibrated directly in degrees Celsius, the device draws 120 µA over the –20 to +100°C range. From $0.57 (3000). **National Semiconductor Corp**, Santa Clara, CA. (800) 272-9959. **Circle No. 331**






**Single-chip, high-speed data-communications controller suits frame-relay applications.** The MK50H28 data-communications controller provides link-level (OSI layer 2) processing for the frame-relay protocol in routers, hubs, asynchronous-transfer-mode (ATM), and other high-performance, point-to-point wide-area-network (WAN) applications. The device has full-duplex data throughput in protocol mode at up to 13 Mbps, allowing you to take advantage of frame relay at T1, E1, and fractional T3 data rates. The chip has firmware that provides up to 8192 data-link connection identifiers in receive and transmit modes. A dual-channel DMA controller and a buffer-management scheme let you transmit and receive multiple data frames at once and chain long frames. $28 (1000). **SGS-Thomson Microelectronics**, Lincoln, MA. (617) 259-0300. **Circle No. 332**

**14-bit, 5-MHz sampling ADC operates from ±5V supplies.** The ET2465 sampling ADC provides a spurious-free dynamic range of –83 dB, an S/N ratio of 82 dB, and a peak-to-peak noise of 1 LSB. The input bandwidth is 30 MHz. The module comes in a 2.5×2.5×0.4-in. package and costs $695 (100). **Edge Technology Inc**, (617) 899-7900. **Circle No. 333**

**Gate-array family offers multigigahertz operating frequencies.** The SCFX family combines the Direct Coupled FET Logic and Source Coupled FET Logic GaAs logic families to achieve

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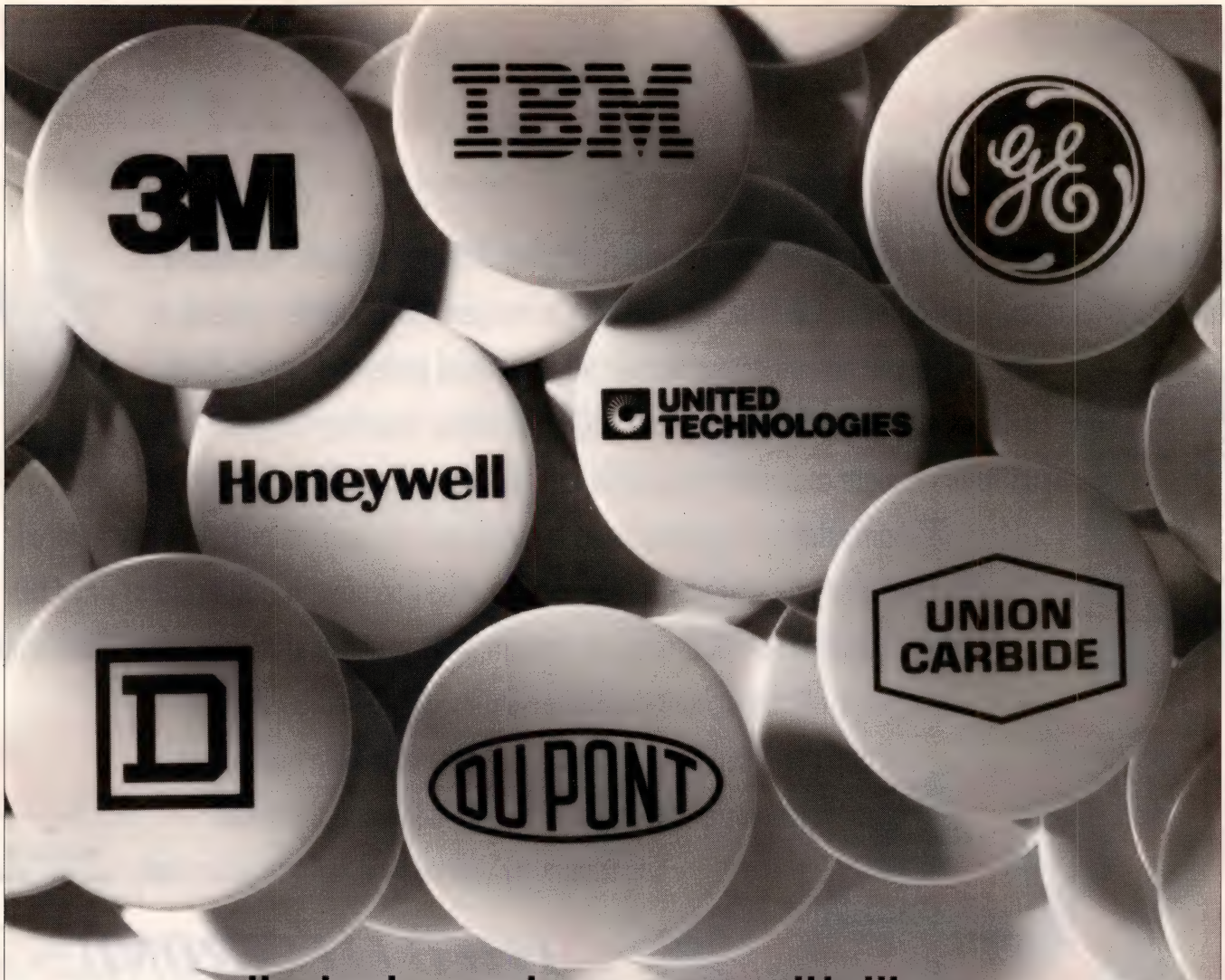


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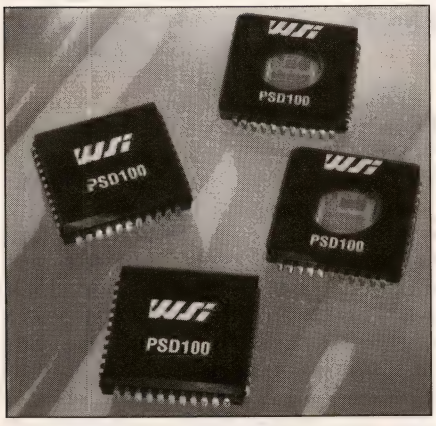
operating frequencies beyond 3 GHz. The arrays offer up to 20,000 gates with a typical unloaded two-input NOR gate having a 37-psec gate delay and 0.2-mW power dissipation. NRE charges start at $35,000, and production prices start at <$0.06/gate (10,000). **Vitesse Semiconductor Corp**, Camarillo, CA. (805) 388-3700. **Circle No. 334**

**Power IC integrates functions for hard-disk drive.** The L6260 power IC contains all the motion-control subsystems for a small hard-disk drive. Functions include a voice-coil positioner for the read/write heads; a brushless motor drive for the spindle motor; and other functions, such as power-on/off sequencing, head parking, and dynamic braking. The circuit operates from 2.7 to 5.5V. The IC comes in a 64-lead QFP and costs $6 (25,000). **SGS-Thomson Microelectronics**, Lincoln, MA. (617) 259-0300. **Circle No. 335**




**Field-programmable DSP peripheral accommodates 50-MHz DSPs without wait states.** The PSD100 provides program and data store plus programmable decode logic that can access external devices. The device has 128 kbits of EPROM, 32 kbits of SRAM, a programmable address decoder, a user-configurable DSP interface, and user-configurable external chip-select outputs. The combined memory- and address-decode time of the device is 35 nsec, and the chip-select-to-output time is 17 nsec. From $9.60 (5000). **WSI**, Fremont, CA. (510) 656-5400. **Circle No. 336**

**Photo-diode and amplifier in SIP accepts light from the side instead of perpendicularly.** The OPT202 combines a 0.09×0.09-in. photo diode, a precision FET-input transconductance amplifier, and a 1-MΩ feedback resistor on a single chip. The device has a 0.45-A/W responsivity at 650 nm, a 400-μA quiescent current, 0.05% nonlinearity, and operates from ±2.25 to ±18V. $4.95 (1000). **Burr-Brown Corp**, Tucson, AZ. (602) 746-1111. **Circle No. 337**

**Plug and Play-compatible SCSI terminator.** The DS21S07A active SCSI terminator provides nine signal-line terminations for migration from an 18-line Narrow SCSI to a 27-line Wide SCSI by adding a single chip. When powered down, the device adds 3 pF of capacitance to the SCSI bus. The terminator's resistors and voltage regulator have a 2% tolerance over the full temperature and voltage range to minimize reflections. The chip also meets all SCSI hot-plugging specifications. $1.60 (10,000). **Dallas Semiconductor**, Dallas, TX. (214) 450-0448. **Circle No. 338**

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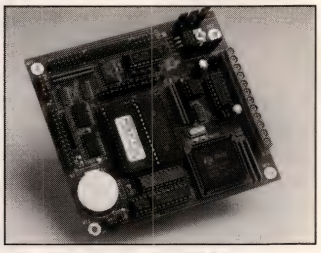
**Development tools for embedded 386/486 systems.** TNT Embedded Toolsuite supports C and C++ compilers from Borland, Microsoft, and MetaWare. The tool suite includes the TNT embedded kernel, the Visual System Builder for customizing the TNT kernel, LinkLoc, a 32-bit linker/-locator, the CVEMB and TDEMB shells for embedded cross-debugging, full support for C and C++ run-time libraries, an MS-DOS-compatible file system, and a floating-point emulation library. $2995. **Phar Lap Software Inc**, Cambridge, MA. (617) 484-4458. **Circle No. 446**

**C source-level cross-debugger is fully integrated with RTXC Kernel.** The ZAP C source-level cross-debugger is a component of the company's Integrated Development Environment for Embedded Applications (IDEA). The cross-debugger features full RTXC kernel awareness and task debugging using no target resources. You can display any of the kernel services, set complex breakpoints in tasks, and modify kernel objects. Other features include a source browser, a graphical-performance-analysis tool, a time line of functions calls, and the ability to scroll back and forth through a series of executed C instructions. The debugger is available for 68HC08, 68HC11, and CPU32 for $1500 (on PCs) and $2500 (on Sun and HP Workstations). **Cosmic Software Inc**, Woburn, MA. (617) 932-2556. **Circle No. 447**

**Real-time development system for ADA is available on Alpha AXP 64-bit RISC computers.** The VADSworks embedded real-time development system for ADA is now available for Alpha AXP 64-bit RISC platforms and VME single-board computers. The real-time development system provides a front end to Digital's VxWorks for Alpha AXP operating system. From $35,000. **Rational Software Corp**, Santa Clara, CA. (408) 496-3600. **Circle No. 448**



**C-programmable controller has 14 digital inputs and 12 digital outputs in 4.5×4.2-in. package.** The Little Genius is designed for OEM-control and data-acquisition applications. The board offers RS232C and RS485 communication; EEPROM; battery-backed RAM and real-time clock; programmable timers; a 9-MHz processor clock; watchdog timer and power-fail interrupt; and an expansion port. Standard version, $149; OEM version, $119; C-development system running on Windows and DOS, $195. **Zworld Engineering**, Davis, CA. (916) 757-3737. **Circle No. 449**

**SPARC-based, embedded-processor board supports Solaris 1, 2, and real-time operating systems.** The TP912 has a microSPARC II processor running at 70 or 85 MHz on a 9.61×8.98-in. board. The system combines the processor with memory, flexible I/O, and an expansion interface. The board accommodates from 2 to 128 Mbytes of DRAM and has four SBus expansion slots. From $2995. **Tadpole Technology Inc**, Austin, TX. (512) 219-2200. **Circle No. 450**

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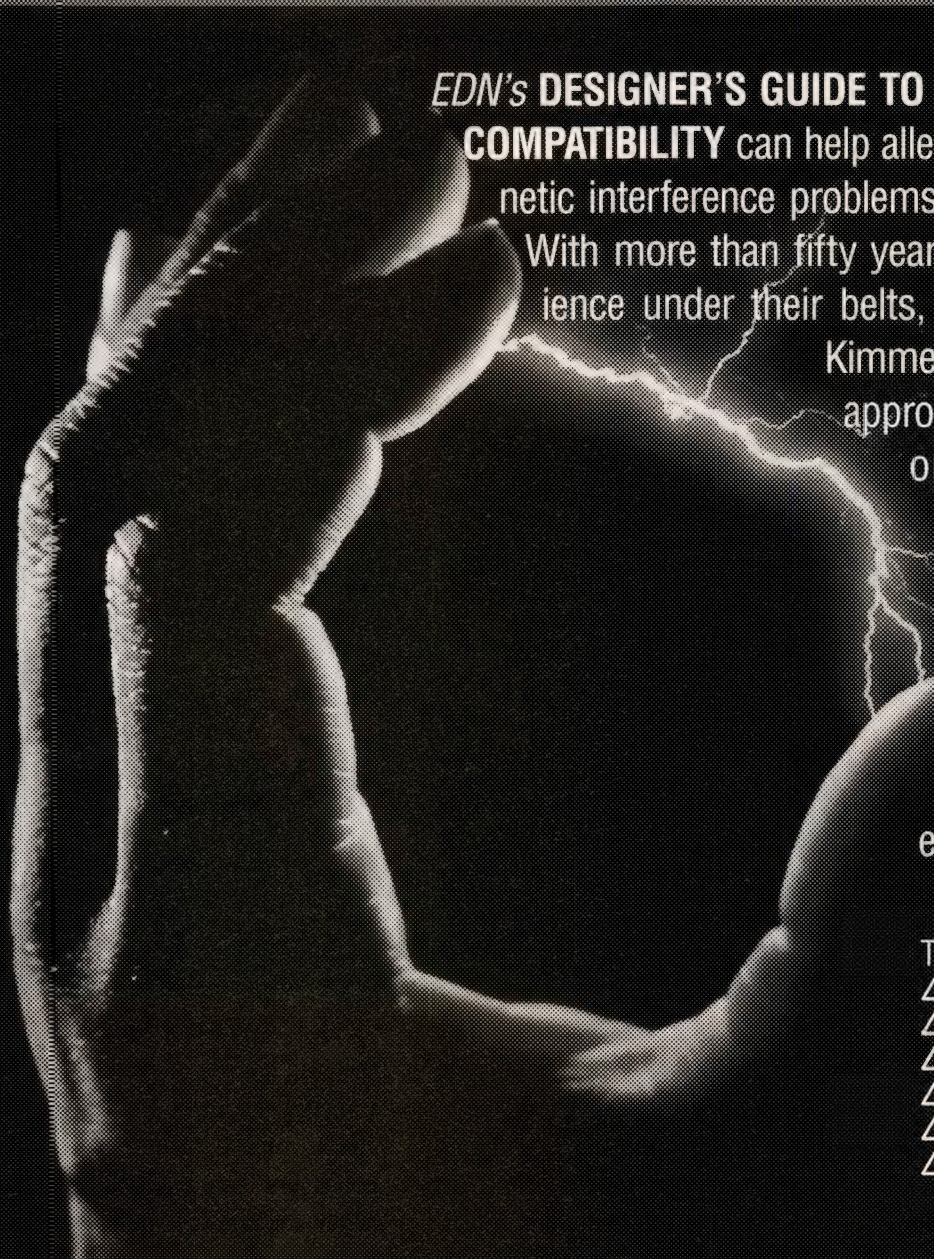

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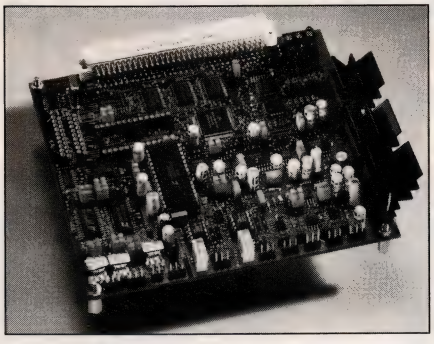
**Multibus II carrier board for IndustryPack modules provides wide range of I/O interfaces.** The IO CBX/PAC is a slave board that connects to the company's Multibus II master boards through the proprietary CBX interface. The board accommodates four single-size or two double-size, 8-MHz IndustryPack modules. IndustryPack modules are available from a number of manufacturers and include counters, quadrature decoders, ADCs, DACs, servo-loop controllers, stepper controllers, and other functions. $1500. **Concurrent Technologies Inc**, Champaign, IL. (217) 356-7004.
**Circle No. 451**

**Embedded-development-tool support for the Intel i960 P110 microprocessor.** A complete development environment, XRAY Masterworks includes C and C++ compilers, the XRAY Debugger, and other tools. The cross-development tool includes XRAY Make, a graphical tool for finding and fixing errors, and XRAY Source Code Management Interface, a graphical interface to source code manager for multiuser environments. From $4680 for the i960 compiler and XRAY Debugger on a PC (other hosts available later). **Microtec Research Inc**, Santa Clara, CA. (408) 980-1300. **Circle No. 452**

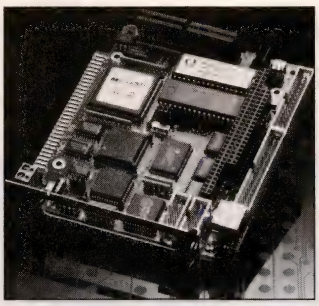


**Stand-alone, digital-audio, signal-processing module.** The M4-1214-B audio processing module offers flexible DSP-algorithm development, prototyping, and OEM production of audio equipment. The module has an overall dynamic range greater than 100 dB, uses the 24-bit fixed-point DSP56004 processor, has an expansion connector for user interface and I/O space, and is capable of independent operation, including booting from on-board program memory. The module includes two 18- or 20-bit analog input channels and four 18-bit analog output channels. Typical applications include digital loudspeaker cross-over equalization, digital studio equipment, sample rate converter, surround-sound decoder, and announcement systems. Audio DSP Module, $995; Evaluation Pack, $1395. **Sample Rate Systems Oy**, Tampere, Finland. 358-31-3165045.
**Circle No. 453**

**32-bit VMEbus development systems tailored for real-time applications.** VMEbus systems tailored to Microware's OS-9 real-time operating system offer a complete suite of tools for factory automation. The tools include ISaGRAF V2.10, a Windows-based automation-code-programming package offering all five IEC1131-3 languages, plus C programming; Profibus fieldbus network technology (DIN 19245); FasTrak, a Unix- and Windows-based, cross-development tool for OS-9; MGR, an operating-system-independent, color, graphical multiwindowing GUI for application development and target-system-operator interfaces. The 3

and 6U systems cost from $6000 to $8000. **PEP Modular Computers**, Scottsdale, AZ. (602) 483-7100.
**Circle No. 454**

**Complete software-development tools for MPC500 μC family.** The software-development tools for the company's MPC500 family of 32-bit PowerPC Architecture μCs also support all products based on the PowerPC Architecture specifications, including PowerPC 600 and IBM 400 families. The tool set suits embedded applications and includes a C compiler, macroassembler, linker, S-record generator, debugger, and archiver. It facilitates the development of ROM-based code and can work with limited RAM and discontiguous memory spaces. The tools are initially available for Sun and IBM workstations for $7500, but the company expects to offer the tools for use under Windows 3.1 by the second quarter of 1995. **Motorola Microcontroller Technologies Group**, Austin, TX. (512) 891-3260.
**Circle No. 455**



**Embedded industrial 486 PC costs <$500.** The 4010-4 measures 4.5×4.9 in. and includes a 25-MHz 486SLC microprocessor, two 16C-450-compatible serial ports, an LPT1 parallel port, a dual floppy-drive port, an AT hard-drive port that supports 2.5- and 1.8-in. hard drives, 2 Mbytes of DRAM, keyboard and speaker ports, and an 8/16-bit PC/104 connector. The PC also has two solid-state disks: the first contains the BIOS, DOS 5.0 in ROM, and a utility library; the second disk accepts an EPROM and flash memory up to 1 Mbyte. Designed for use in industrial applications, the board operates over a –40 to +65°C temperature range and withstands 20g shock and 5g vibration. **Octagon Systems**, Westminster, CO. (303) 430-1500.
**Circle No. 456**

**Software and hardware simplify the development of international DSP-based telephony products.** Software for the company's Mwave MDS-P2780 digital signal processor lets you develop telephony products based on one hardware and software reference design that complies with the specific telephony requirements of 21 countries. The communication software locates country-specific information in a set of tables PC users can select via a user dialog box instead of having to reconfigure the system. Users must also change a DAA cable. Hardware, $19 (100,000); software, $12 (10,000). **IBM Microelectronics**, Fishkill, NY. (800) 426-0181, ext 500.
**Circle No. 457**

**Software-development environment for i960 includes optimizing C compiler and assembler.** The development environment supports the entire i960 family and is hosted on HP 9000/700 series workstations, DEC VAX/VMS systems, and Sun SPARCstations. The software includes a macro cross-assembler, instruction-level simulator, profiler, linker, archiver, and disassembler. From $8000. **Irvine Compiler Corp**, Irvine, CA. (714) 250-1366.
**Circle No. 458**

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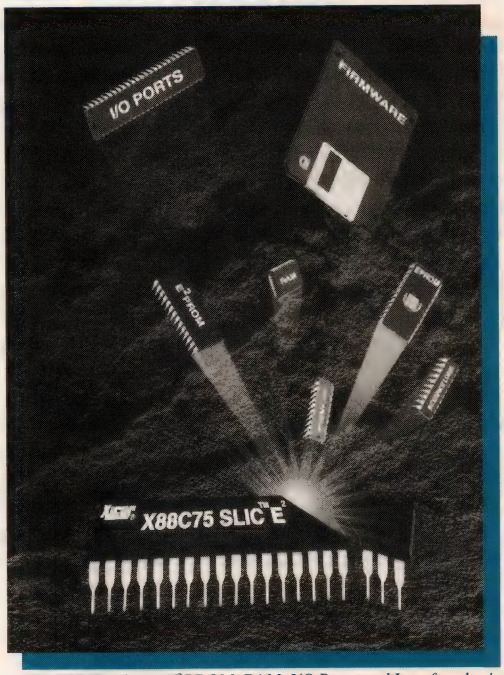
# Design Engineering Bulletin

New Product and Applications Information for Design Engineers

## X88C75 SLIC® E² Microcontroller Peripheral adds I/O ports, E²PROM, Static RAM, Interrupt controller and Address Decoding Logic to 80C31 Family

The X88C75 SLIC Microcontroller Peripheral is the ideal enhancement to 80C31 type systems. The device features 8K Bytes of E²PROM which may be used for either program or data storage and 16 bytes of static RAM for data parameter storage. The sophisticated 16 I/O lines are configurable as either Inputs or Outputs with two additional strobing signals for either latching data into the ports or for strobing data out. The Programmable Interrupt controller can be configured to generate interrupts from either data input into the ports or the completion of the internal E²PROM write cycle. The E²PROM features concurrent read during write operation which allows the controller to continue program execution from the E²PROM during a write cycle to the same device.

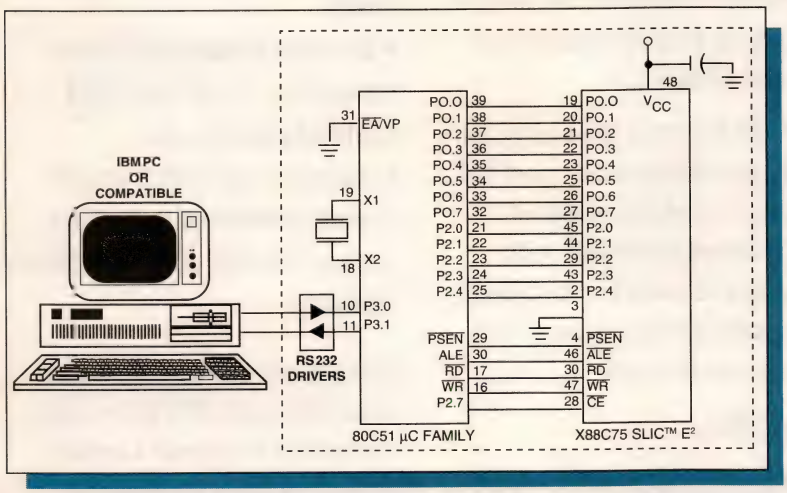
All internal resources are memory mapped and their location is programmable through the internal nonvolatile programmable decoder. This allows multiple X88C75 SLIC devices to be used to provide up to 64K bytes of E²PROM, 128 Bytes of RAM and 128 I/O lines without any additional logic. The X88C75 SLIC device also features an optional LAM (Latched Address Mode) mode of operation where the 8-I/O lines of port B are used to output the de-multiplexed low order address byte of the 80C31 bus. This simplifies the inclusion of standard byte-wide memory devices such as SRAM, NOVRAM or EPROM into the system applications.




*X88C75 Combines E²PROM, RAM, I/O Ports and Interface logic into an integrated, cost effective E² Micropheripheral.*

## X88C75 SLIC Provides Complete Solution to Firmware in Embedded Systems

The need for software upgradability is becoming increasingly important in embedded systems. The X88C75 SLIC device provides a complete hardware and software solution to this need. The device is delivered with a small library of routines loaded into the device. Upon initial power-up, the 80C31 will be initialized, and the SLIC firmware will download the applications software through the UART on the 80C31. Subsequent downloads can be performed by re-invoking the SLIC firmware to allow the applications software to be changed once the system is in the field. The software update can be performed over an RS232 interface, a network connection, a local serial bus, RF link or a fiber optics cable. The updates may be performed in a random fashion allowing a single byte, numerous bytes or the entire applications program to be updated.




*Upon initial power-up, the 80C31 will be initialized, and the SLIC firmware will download the applications software through the UART on the 80C31.*

Designing systems based on the X88C75 SLIC E² is simplified by making the SLIC firmware routines readily available to the application software. A PC based program called XSLIC was developed to handle the X88C75 SLIC to host system interface. The XSLIC facilitates reconfiguration of the communication link parameters and downloading application programs to the target system. Provisions have also been made to relocate the SLIC firmware in case of address conflicts with on chip resources of the 80C51 derivative employed by the system.



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**Verilog book includes simulator.** The 304-pg book *The Verilog Hardware Description Language*, Second Edition, includes the VeriWell simulator from Wellspring Solutions (Sutton, MA). The DOS version of the simulator has a 1000-line capacity and complies at the behavioral and register-transfer levels with the Open Verilog International standards. $98. **Kluwer Academic Publishers**, Norwell, MA. (617) 871-6600.
**Circle No. 435**

**Version of pc-board-design tool runs under Windows.** The 8.0 version of P-CAD Master Designer runs under DOS, Unix, and Microsoft Windows 3.1. The version has enhanced macro capabilities, expanded libraries, and user-requested improvements. From $1995. **Altium Inc**, San Jose, CA. (408)534-4140.
**Circle No. 436**

**Dynamic electromagnetic simulator suits electromechanical system.** The Maxwell EM system simulator performs time-domain simulation of electromagnetic devices, including mechanical motion and Spice models of driver and load circuitry. The simulator lets you combine electromagnetic-device characteristics with equations of motion and circuit excitation to predict the behavior of the electromechanical system. Typical applications are electric motor systems, transformers, and actuators. The 3-D version of the simulator will be available in the second quarter of 1995 and will cost $19,900 on PCs and $24,900 on workstations. The 3-D version will cost $44,900 for both PCs and workstations. **Ansoft Corp**, Pittsburgh, PA. (412) 261-3200. **Circle No. 437**

**Architectural-synthesis tools expand VHDL and add Verilog support.** The Mistral 1 and Mistral 2 true architectural-synthesis tools for DSP design support Verilog-based synthesis tools from Synopsys and VHSIC hardware-description-language (VHDL)-based logic-synthesis tools from Synopsys and Cadence. The behavioral-synthesis tools let you synthesize complex DSP architectures based on behavioral algorithmic descriptions. The Verilog and VHDL enhancements are free to current customers. Mistral 1 costs $30,000, and Mistral 2 costs $100,000. **Mentor Graphics**, Wilsonville, OR. (503) 685-8000. **Circle No. 438**

**ASIC-emulation systems for large designs and HDL-level emulation.** The System Realizer family of emulation systems emulates multiple ASICs and complex, custom ICs. You can configure the system for 250,000 to 3 million gates; prices range from $240,000 to $3,994,000. The system includes timing-correction design-mapping and debugging software. The HDL-ICE ASIC-emulation system accommodates 250,000 gates at the hardware-description-language (HDL) level. The system also accepts register-transfer-level (RTL) or mixed RTL and gate-level formats. A Verilog version costs $275,000, and a VHDL version is scheduled

for the first quarter of 1995. **Quickturn Design Systems**, Mountain View, CA. (415) 967-3300. **Circle No. 439**

**Test-vector and -fixture design-and-verification tools reduce on-tester debug time.** The digital Virtual Test (VT) system provides verification tools for vector-code and test-fixture designs. The product works off-line before silicon to reduce on-tester debug time. With the vendor's other tools, the software also helps verify acceptable test-fixture signal integrity. VT for IMS test stations costs $22,500. **Cadence Design Systems Inc**, San Jose, CA. (408) 943-1234. **Circle No. 440**

**Schematic-capture system for Windows adds features.** The Synario Capture System (SCS) version 2.7 schematic-capture system works in multiple windows and on multiple tasks. It provides back annotation, hierarchical design, unlimited Undo/Redo, crash recovery, on-line analysis tools, a waveform editor, and a waveform viewer. Version 2.7 improves attribute editing and adds compressed libraries and interprocess communication, which allows cross-probing with pc-board-layout tools. The Synario Universal field-programmable gate-array design system includes portions of SCS. From $995. **Data I/O**, Redmond, WA. (206) 881-6444. **Circle No. 441**

**Complex-IC-design software adds Verilog support.** The 3.0 release of this hardware-design system generates Verilog hardware-description language (HDL) in addition to VHSIC HDL. The software generates the HDLs from a graphic-design specification. The tool also offers HDL import and cosimulation through links between the product's system-level simulator and other HDL simulators. Target applications for the tool include wireless communications, networking, and multimedia. Prices for the software start at $10,000 for users of the company's SPW; otherwise, prices start at $35,000. **Alta Group**, Foster City, CA. (415) 574-5800. **Circle No. 442**

**Analysis tool for high-speed design links to major layout-tool vendors' products.** UniSolve-Link links the company's UniSolve analysis tool set to layout tools from Mentor Graphics, Zuken-Redac, and Cadence. The UniSolve tool set analyzes the physical effects of high-speed design, including EMI, digital- and analog-signal integrity, thermal effects, and reliability. You can transfer geometry changes in the tools to the host system. $3500. **Uni-CAD**, Westford, MA. (508) 692-8446. **Circle No. 443**

**Vital 2.2b package for VHDL simulator improves gate-level simulation speed.** The Vital (VHDL Initiative toward ASIC Libraries) 2.2 package improves the gate-level simulation speed of its QuickVHDL simulator by up to 10×, according to the vendor. The simulator includes VHDL Technology Group's Std_DevelopersKit (SDK) to reduce model-development time. The simulator includes the above products and costs $14,950. **Mentor Graphics**, Wilsonville, OR. (503) 685-8000. **Circle No. 444**

## EDN MICROPROCESSORS

**Low-cost 80C51 derivatives.** The 16-MHz 8xC748 and 8x749 8-bit microcontrollers include 2 kbytes of program memory and suit battery-powered low-cost applications. The 8x749 includes an ADC and pulse-width-modulated output for analog applications. EPROM one-time-programmable and mask-programmed versions are available. The 24- and 28-pin SSOP parts measure 2 mm high. The ROM versions cost $2 (83C748) and $3.20 (83C749) (5000). **Philips Semiconductors,** Eindhoven, The Netherlands. (31) 40 722091. **Circle No. 316**

**Ten microcontroller variants designed for telecomm applications.** Many members of this µC family, which is based on the M68HC05 8-bit µC core, have an onboard DTMF/melody generator, which provides DTMF dialing, melody-on-hold, and pacifier tone functions. The 68HC05F5 includes a DTMF receiver that detects and qualifies DTMF signals. The µCs also include features that support simple phone applications such as two-channel cordless phones, complex phones with multiple channels, speaker phones, number storage, and LCD capability. Prices depend on features and quantity; the 68HC05F5 costs <$3 (100,000). **Motorola Microcontroller Technologies Group,** Austin, TX. (512) 891-6503. **Circle No. 317**

**32-bit µP is 0.05 in. thick.** The T400 20-MHz 32-bit microprocessor has a 0.05-in.-thick TQFP outline to meet tight packaging applications. The RISC-core device features a PLL clock generator, hardware schedulers, and a programmable memory interface. The STEK400 PC-based development kit ($595) includes target hardware and ANSI C-programming tools. $20 (volume). **SGS-Thomson,** Bristol, UK. (44) 454 611622. **Circle No. 318**

**DSP targets parallel-processing telecomm applications.** At $99 (10,000), the TMS320C44 reduces the cost of floating-point DSPs to suit high-volume, multiprocessor telecomm applications. The 'C44 is software compatible with the 'C40 but differs in having a reduced pin count, a low-cost plastic package, and lower power requirements—including power-management capabilities. The $99 suggested price is for the 40-MHz version; a 50-MHz version is also sampling. **Texas Instruments Inc,** Denver, CO. (800) 477-8924, ext 4500. **Circle No. 319**

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**PLCC-to-DIP adapter accommodates 28-, 44-, 68-, and 84-pin devices.** The Series 652000 adapters have mounting pads on the top for soldering PLCC devices. The Series 653000 have a PLCC socket on the top for direct plug-in of PLCC devices. Both have DIP pins on 0.600-in. centers. A 28-pin 652000-10 adapter costs $3.30 (1000). **Aries Electronics Inc**, Frenchtown, NJ. (908) 996-6841. **Circle No. 396**

**Plastic axial cooling fan is lightweight.** The 4715 KL axial cooling fan provides performance similar to that of aluminum-frame fans but is all plastic, resulting in a lighter weight. The fan's frame measures 120×38 mm, and the fan comes in four airflow rates. $10 (1000). **NMB Technologies Inc**, Chatsworth, CA. (818) 341-3355. **Circle No. 397**

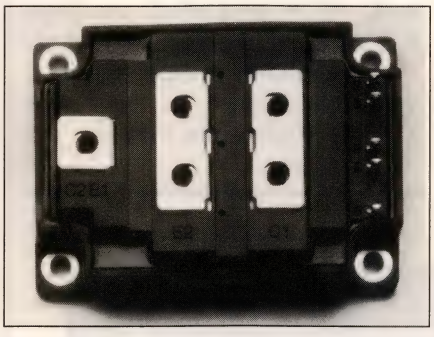
**Surface-mount LEDs have 12.5- to 80-mcd luminous intensities.** The ceramic-package LEDs measure 3×2×1 mm and come in ultrabright red, high-efficiency red, yellow, and superbright green. The LEDs are rated at 20 mA current and have a typical forward voltage of 2V. The operating temperature range is –40 to +85°C. $0.25 in quantity. **Gilway Technical Lamp**, Woburn, MA. (617) 935-4442. **Circle No. 398**

**Wire-to-board connectors have integral LC-filter networks to reduce EMI.** The JLF 2.5-mm-pitch, eight-circuit header is rated for 3A at 50V ac/dc. It mates with the Series XHF wire-to-board, disconnectable, crimp-style connector. $3 to $4.50. **JST Corp**, Mount Prospect, IL. (708) 803-3300. **Circle No. 399**

**4×4.5-mm radial ceramic trimmer capacitors are taped for automatic insertion.** The GKG 25 series capacitors suit automatic insertion in high-volume lead through-hole assemblies. Seven models are available with capacitance ranges of 1.4 to 3 through 8.5 to 50 pF. Color-coded plastic housings identify the capacitance range. The operating voltage rating is 100V dc over a –25 to +85°C range. Dielectric-withstand voltage is 220V dc. $0.35 (1000). **Sprague-Goodman Electronics Inc**, Westbury, NY. (516) 334-8700. **Circle No. 400**

**Fuse clip allows autoinsertion using conventional radial lead-insertion equipment.** The HTC-200M pc-board-mount fuse clip accommodates 5-mm fuses in 15- or 20-mm lengths. The fuse clips are made of tin-plated bronze and cost $0.073 (1000). **Bussmann**, St Louis, MO. (314) 394-2877. **Circle No. 401**

**Toroidal inductors and transformers for surface mounting.** The surface-mount toroidal inductors/transformers (SMITs) operate as single or dual inductors or as 1-to-1 transformers. The products come in 11 values from 10 to 1000 µH and four case sizes. The surface-mount lead design provides positive standoff for solder-fillet formation and solder-flux washing. From $5 (1000). **Engineered Components Co**, San Luis Obispo, CA. (805) 544-3800. **Circle No. 402**



**1200V IGBT provides rugged short-circuit capabilities.** The MG50Q-2YSXX insulated-gate bipolar-transistor (IGBT) series is available in current ranges from 50 to 400A and offers a 0.2-µsec switching time. The transistor features a nonpunch-through chip structure that provides rugged dynamic electrical behavior with respect to short circuits and a square reverse-bias safe-operating area. Samples will be available in the fourth quarter. $55 (100). **Toshiba America Electronic Components Inc**, Irvine, CA. (800) 879-4963. **Circle No. 403**

**15W combiner/splitter offers 200- to 500-MHz frequency range and a 0.3-dB typ insertion loss.** The ZA2CS-500-15W two-way, 0° combiner/splitter module has 30-dB typical isolation, 0.1-dB amplitude unbalance,

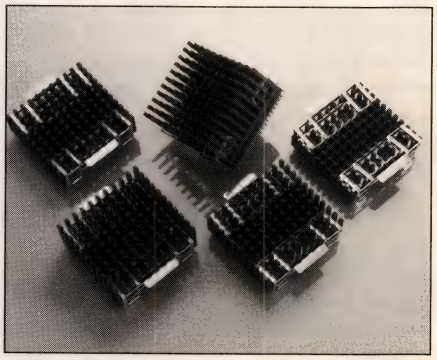
and a phase unbalance down to 0.3°, typ. The VSWR is 1.15-to-1. BNC connectors are standard; SMA and type-N are optional. $74.95. **Mini-Circuits**, Brooklyn, NY. (718) 934-4500.

**Circle No. 404**

**Solderless connectors have 50-μm pitch.** The GB range of custom solderless connectors comprises a row of gold-plated wires set in silicone-rubber support material. The design suits the connection of two parallel boards, although other configurations are possible. The wires have 30- or 40-μm thickness and a 50- or 100-μm pitch. Current-carrying capacity per wire is 50 mA, and contact resistance is <100 mΩ. **ShinEtsu**, Venlo, the Netherlands. (31) 77 877600. **Circle No. 405**

**Thick-film power resistors in TO-220 package offer 20W power dissipation.** The RTO-20F and RTO-20C offer up to 20W power dissipation with copper heat sinks. The resistors are available in values from 0.05Ω to 1 MΩ with tolerances of 1, 2, 5, and 10%. The standard temperature coefficient of resistance is ±100 ppm/°C, and ±50-ppm/°C devices are available. A noninductive design keeps the inductance <0.1 μH. $3.11 (1000) for 1Ω, 1% resistors. **Vishay Resistors**, Malvern, PA. (610) 644-1300. **Circle No. 406**





**Heat sinks for Pentium processors install without tools.** The Penguin Coolers 799 Series SocketClip operates with 90- and 100-MHz Pentium processors. The heat sinks attach without tools to 296- and 320-pin low-insertion-force sockets. They install over the processor with four-point loading and an audible and tactile click to indicate secure latching. The heat sink assemblies are available in of 0.650-, 0.800-, and 1-in. heights and fit 19×19-pin interstitial pin-grid arrays. $1.59 (10,000). **Wakefield Engineering Inc**, Wakefield, MA. (617) 245-5900.

**Circle No. 407**

**Disposable carrier lets you mount through-hole ICs on surface-mount boards.** The carrier is configurable for DIPs, SIPs, ZIPs, pin-grid arrays and other component types. You can insert the through-hole component manually or automatically. After soldering, the connecting film is peeled away with tweezers and discarded, permitting inspection of solder joints. $0.03.5 to $0.04.5/pin in OEM quantities. **Socket Express**, New Brunswick, NJ. (908) 247-9500.

**Circle No. 408**

**Pluggable pc-board terminal block includes strain-relief grip.** You can disconnect the Eurostyle Series 86 terminal block from a pc board by pulling on a strain-relief grip. The grip avoids pulling directly on the wires and elim-

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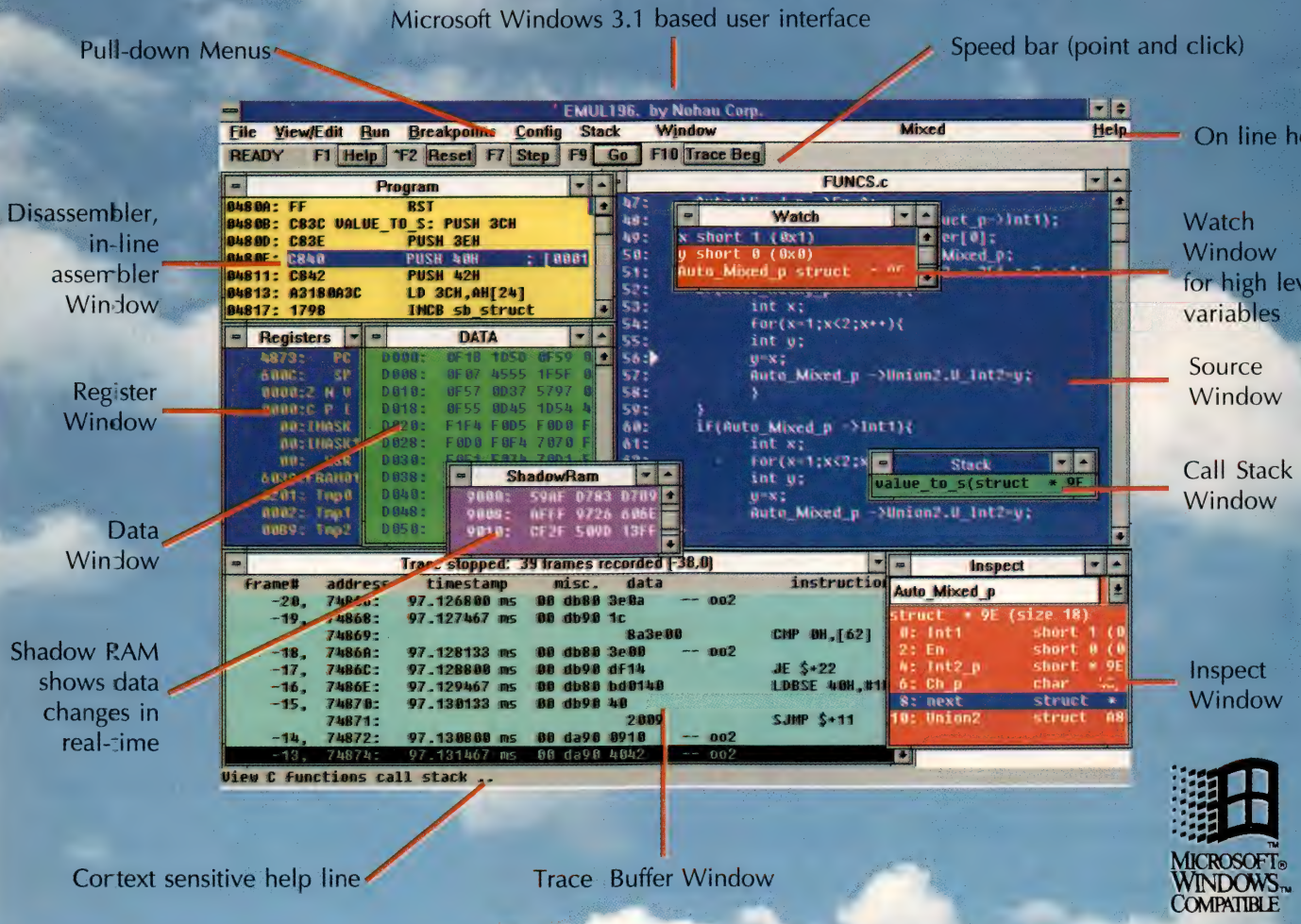


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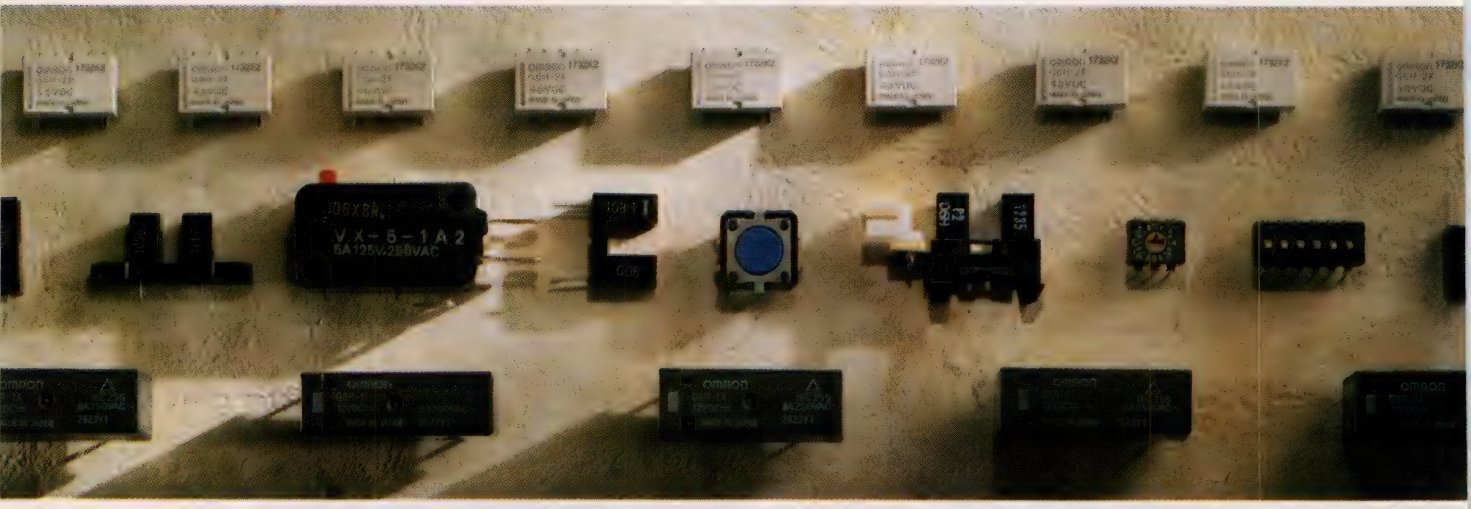

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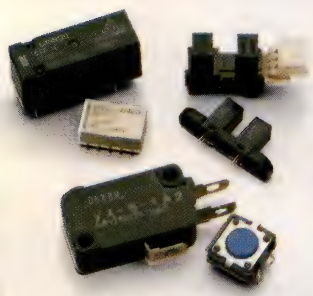

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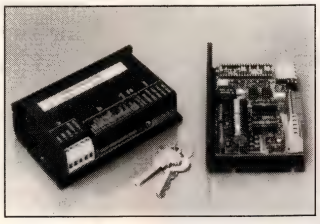
inates the possibility of damaging wires. The terminal block is a right-angle plug that is polarized using an industry-standard scalloped design. It mates with competitive pluggable headers. Rising-cage-pressure clamps hold wires with a positive grip. The terminal blocks come with six to 16 terminals on 0.200-in. centers. The blocks accept wires from 12 to 30 AWG. $0.40 per circuit (1000). **Beau Interconnect Systems Division of Vernitron Corp**, Laconia, NH. (603) 524-5102.

**Circle No. 409**

**5V electric cooling modules for computer applications.** The 5V thermoelectric coolers use the Peltier effect for localized cooling. The CP/5V family measures 0.125 to 2 in.$^2$. Nine versions draw 2.1 to 14A and provide temperature differentials of up to 70°C. Operating life exceeds 200,000 hours. Typical price for a 0.75-in.$^2$ device is $10.95 (100). **Melcor**, Trenton, NJ. (609) 393-4178.

**Circle No. 410**



**Servoamplifier provides trim-pot-free option.** The Model 412 servoamplifier lets you insert fixed resistors into a component header. This technique lets you replace trim pots for OEM production runs, once you establish amplifier-motor tuning values. The PWM servoamplifier operates at a 25-kHz switching frequency and accommodates motors with 0.2- to 40-mH inductance. The amplifier develops ±20A pk current and ±10A continuous current at ±90V. $280. **Copley Controls Corp**, Westwood, MA. (617) 329-8200.

**Circle No. 411**

**Right-angle spacer interconnects available in 0.100-in., 2-mm, and 0.050-in. spacing.** The right-angle spacer interconnects are available with standoff heights up to 0.400 in. In addition to providing proper spacing between pc boards, the spacing interconnects eliminate the need for spacing hardware and secondary wiring. You can apply these interconnects solder-to-solder, solder-to-socket, or socket-to-socket. Mating sockets are available. The spacer interconnects cost $0.003/contact in volume. **Comm Con Connectors Inc**, Duarte, CA. (818) 301-4200. **Circle No. 412**

**Digital-to-synchronous converter is reference-powered.** The 2.6 ×3.1-×0.51-in. module accepts a 14-bit natural binary angle and converts it into a three-wire synchronous signal. The module requires only 5V-dc input power and provides 4.5-VA load capability on the 400-Hz units and 2 VA on the 60-Hz units. $595 in OEM quantities. **Computer Conversions Corp**, East Northport, NY. (516) 261-3300.

**Circle No. 413**

**Polypropylene film capacitor has 85°C rating.** The PHC capacitor family comes in capacitance values from 0.15 to 30 μF. Applications include high-frequency electronic ballast, motor-speed controls, switch-mode power supplies, motors, general-purpose ac applications, audio, and as an alternative to electrolytic capacitors at

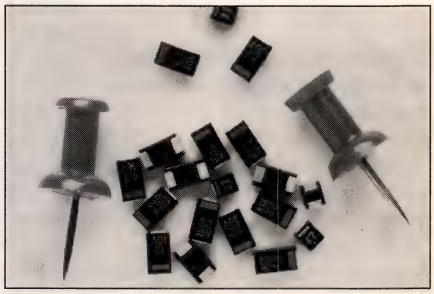
high frequencies. Voltage ranges are 250 to 850 WV dc and 160 to 450 WV ac. The dissipation factor is 0.06% max at 1 kHz and insulation resistance is greater than 30,000 MΩ/μF. From $.48 (1000). **Illinois Capacitor Inc**, Lincolnwood, IL. (708) 675-1760.

**Circle No. 414**

**Fully sealed subminiature toggle and rocker switches for pc-board mounting.** The TL and TR series of switches have a one-piece case that provides sealing to withstand the soldering and cleaning typically used in manufacturing. The switches are available in a variety of configurations, including single- and double-pole, straight, right-angle vertical, and right-angle horizontal. The single-pole models measure 0.196 wide×0.318 long×0.318-in deep. The double-pole model is 0.358 in. wide. Price for the single-pole TL36P00 is $2.23 (1000). **Mors/Asc**, Wakefield, MA. (617) 246-1007. **Circle No. 415**

**Multistage thermoelectric coolers suit electro-optical applications.** The multistage thermoelectric coolers (TECs) offer low-current operation in a small size, making them suitable for applications requiring maximum cooling in minimum space. Possible uses include CCD cameras, laser diodes, IR detectors, fiber optics, thermal imaging systems, and spectrophotometry. Sizes for the TECs range from 1.8×3.4 to 12.3×14.4 mm. Maximum current ratings range from 800 mA to 2A, providing maximum temperature differentials of 67 to 83°C. The two-stage 2FC025040-16-8 TEC costs $49.35 (50). **Melcor**, Trenton, NJ. (609) 393-4178.

**Circle No. 416**



**Solid-tantalum electrolytic chip capacitors offer low inductance.** The TC series of Tantalum electrolytic capacitors are available in capacitance ranges of 0.1 to 68 μF and voltage ratings from 4 to 35 V dc. They come in ±10 and ±20% tolerance ranges. The operating-temperature range is –55 to +125°C. EIA case sizes are 3216, 3528, 4726, 6032, and 7343. From $0.13 (1000). **Paccom Electronics**, Redmond, WA. (206) 883-9200 **Circle No. 417**

**19-in., rack-mount enclosure provides space for eight 3.5- or 5.25-in., half-height drives.** The redundant array of inexpensive disk drives (RAID)-ready, rack-mount enclosure also accommodates four 5.25-in., full-height drives. The eight-wide model features hot-swappable, removable modules that house a high-output power supply for each drive. The removable-module design allows easy replacement if a drive, fan, or power supply fails. The device also includes SCSI I/O ports, SCSI-ID address switches, disk-activity LED connectors, power connectors, and cables. An optional alarm board monitors temperature, fan speed, and power supplies. From $730. **Trimm Industries**, North Hollywood, CA. (818) 764-9500.

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**Pen-based computer has embedded wireless communication.** The Badger GT-486P2 pen-based outdoor handheld computer is ruggedized to withstand harsh environments or industrial field conditions. The 3.5-lb computer has embedded-wireless options for cellular/CDPD, ARDIS, RAM, and Spread Spectrum communications. The computer uses a 25-MHz Cyrix 486SLC microprocessor, a 40-Mbyte drive upgradable to 128 Mbytes, and 4 Mbytes of RAM upgradable to 20 Mbytes. Other features include a 6-in. VGA display, PCMCIA slots, and I/O ports for serial, parallel, external keyboard, external display, and fax/modem. $4495. **Badger Computers**, Tampa, FL. (800) 322-3437. **Circle No. 421**

**Graphics accelerator uses Weitek P9100 and P9130.** The Tornado graphics accelerator PC plug-in card uses Weitek's P9100 graphics processor, with the option of a P9130 power video accelerator. The board includes 4 Mbytes of VRAM and IBM RG525 220-MHz RAMDAC video-clock ability. The board provides 16.7 million true-color 1280×1024-pixel resolution, or 65,536-color, 1600×1280-pixel resolution at 80-Hz refresh. The device costs £499, including software drivers for Windows, Windows NT, OS/2, AutoCAD, and Microstation PC. **Datapath**, Derby, UK. (44) 332 294441. **Circle No. 422**

**Portable PC features expansion for add-in cards.** The StealthBOX portable PC provides space for up to four full-size card slots to add capabilities such as CD-ROM, tape backup, and high-capacity disk drives. Systems are available in ISA, EISA, VESA LB, and PCI buses. Processors range from a 386SX to the Pentium. RAM capacity is from 4 to 64 Mbytes. Disk-drive options range from 120 Mbytes to 2.1 Gbytes. Display options are active-matrix TFT color, dual-scan color, gas plasma, and LCD monochrome. From $2200. **Stealth Computer Corp**, Toronto, ON, Canada. (416) 674-3800. **Circle No. 423**

**Low-cost digital playback audio adapter for ISO/MPEG-1 and Dolby AC/2 compression formats.** The Series 2/Model SX-9 audio adapter has playback rates to 50 kHz. The board is compatible with balanced and unbalanced analog and AES/EBU or S/PDIF digital input and output. The audio-adapter board is $1295 and the audio developers kit is $750. **Antex Electronics Corp**, Gardena, CA. (310) 532-3092. **Circle No. 424**

**CD-ROM accelerator software copies critical data to hard disk.** The d-Time Version 1.1 software

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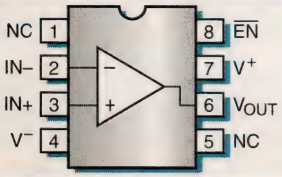
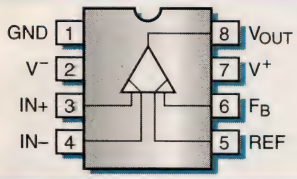
|  | **Very Low Power with Superb Video Performance. Singles and Duals*** | ■ 1 mA/70 MHz/±5V (2176)<br>■ 3 mA/250 MHz/±5V (2186)<br>■ Disable/Power Down to 0 mA<br>■ From $1.99 – 1K Units<br>■ *Duals Available Dec. '94 | ■ Low Power/Portable Applications<br>■ Cable Drivers<br>■ Video Amplifiers<br>■ RGB Amplifiers |
| **INSTRUMENTATION** | **EL4430C/EL4431C/EL4432C** | | |
|  | **Industry Leading Video Instrumentation Amplifiers** | ■ High CMRR of 70 dB at 4 MHz<br>■ Low 0.02% dG, 0.02° dΘ<br>■ 80 MHz –3 dB BW from ±5V to ±15V<br>■ From $3.00 – 1K Units | ■ Differential Line Receivers<br>■ "Loop-Through" Interfaces<br>■ Low-Level Preamplification<br>■ Level Translation |
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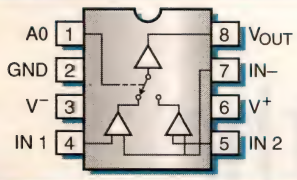
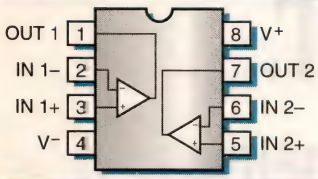
|  | **Pixel Switching 2 and 4 Input with Outstanding Video Performance** | ■ 8 nsec Switching Time<br>■ >80 dB Isolation at 4 MHz<br>■ 80 MHz –3 dB Bandwidth<br>■ From $3.76 – 1K Units | ■ Input Selectors<br>■ "Picture-in-Picture" Switching<br>■ Gain Switching<br>■ Text Insertion |
| **CURRENT MODE** | **EL2166C/EL2160C/EL2260C/EL2460C** | | |
|  | **High Performance Single, Dual, Quad CMF Amplifiers** | ■ 130 MHz –3dB BW @ $A_V$ = +2<br>■ 80 mA Peak Output Current<br>■ 1500V/µs Slew Rate<br>■ Disable Pin on EL2166C<br>■ From $2.57 – 1K Units | ■ Video Amplifiers<br>■ Cable Drivers<br>■ RGB Amplifiers<br>■ Test Equipment Amplifiers |
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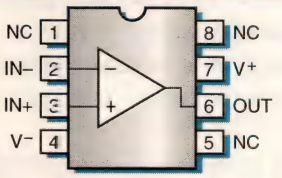
|  | **Combines High Speed with Precision DC Capability. Singles and Duals*** | ■ $T_S$ = 85 ns to .01% (2175)<br>■ $V_{OS}$ = 0.5 mV, $I_{B-}$ = 2µA<br>■ 30 MΩ Transimpedance<br>■ 86 dB CMRR<br>■ From $2.93 – 1K Units<br>■ *Duals Available Dec. '94 | ■ Instrumentation Circuitry<br>■ Low Distortion Communications<br>■ Medical and CCD Imaging<br>■ DAC/ADC Output Amplifier/Buffer |
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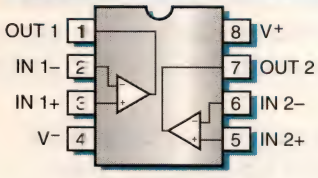
|  | **Low Cost Duals, Triples, Quads for Consumer Video** | ■ Stable @ Gain of 1 and 50 MHz-GBWP (2210, 2310, 2410)<br>■ Stable @ Gain of 2 and 100 MHz-GBWP (2211, 2311, 2411)<br>■ Drives 150Ω Video Loads<br>■ Inputs/Outputs Operate to Neg. Rail<br>■ 60 Cents/Channel in High Volume O.E.M. | ■ Consumer Video<br>■ Active Filters/Integrators<br>■ Cost Sensitive Applications<br>■ Single Supply Amplifiers |

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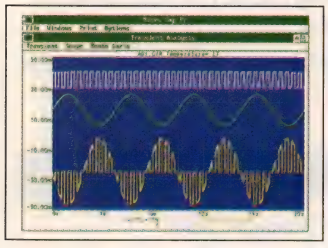

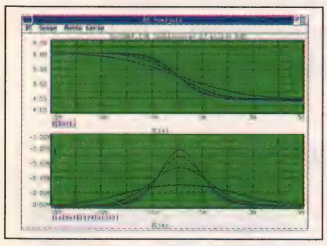

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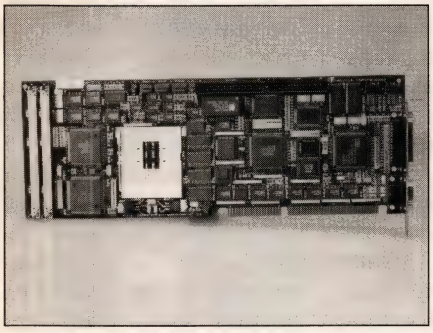
improves the effective access time and data-transfer rate for CD-ROMs, according to the manufacturer. The software removes all glitches and pauses from multimedia sequences and saves 0.2 sec for each CD-ROM access. The company claims the device reduces 20-minute CD-ROM database searches to 1 minute. $69.95. **Ballard Synergy Corp**, Silverdale, WA. (206) 656-8070. **Circle No. 425**



**486-based single-board computer has PCI local bus and IDE controller.** The SB486PV series of single-board CPUs is based on the standard AT passive backplane form factor. The board suits new passive-backplane systems and upgrades of older systems. The series offers seven processor- and clock-speed combinations ranging from the 80486SX/25 to the 80486DX4/33/100. $1395 for the 486SX/33 MHz to $2745 for the 486DX4/33/100 MHz. **Industrial Computer Source**, San Diego, CA. (800) 523-2320. **Circle No. 426**

**Parallel port SCSI adapter lets you attach up to seven devices.** The RT8000 SCSI adapter is IEEE 1284 compliant and may be used with other devices daisy-chained to the printer port. The adapter lets you access a SCSI device as you send a file to the printer. A standard external version costs $179, and an unpackaged adapter is $119 (OEM). **Rancho Technology**, Rancho Cucamonga, CA. (909) 987-3966. **Circle No. 427**

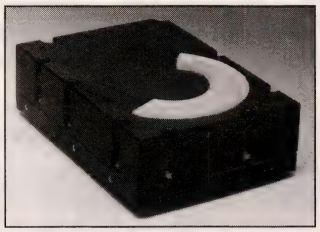
**Four-channel serial-port board for PCs has 460-, 800-bps data rate.** The Blackboard-4 uses 16550 UARTs and accommodates interrupt requests 2, 3, 4, 5, 7, 10, 11, 12, and 15. The board suits bulletin-board systems and has a watchdog circuit that performs a hardware reset if the system crashes or freezes. $295. **Gtek Inc**, Bay St Louis, MS. (601) 467-8048. **Circle No. 428**

**Utility library for OS/2 includes 640 products.** The OS/2 utility library is a collection of public-domain and shareware programs for OS/2 2.x. The programs have been compressed with PKZIP onto 66 1.44-Mbyte diskettes and onto CD-ROM. The library includes a directory database that lets you search by product name, type, vendor, release date, or with a free text search. The library costs $59.50 as part of a two-CD-ROM set or $99.50 on 66 diskettes. **EMS Professional Shareware**, Olney, MD. (301) 924-3594. **Circle No. 429**

**Tape-drive backup system provides unattended automatic backup of PCs.** The Autobahn Tape 250, a ¼-in. Cartridge-80 standard format tape drive, stores 250 Mbytes with a transfer rate of 8 Mbytes/minute. The unit plugs into a PC's parallel port and is Windows- and DOS-compatible. The unit is 4.75 in. wide, 8 in. long, and 2.5 in. high. $350. **Portable Solutions Inc**, Anaheim, CA. (714) 632-1123.

**Circle No. 430**

**486-based system board for <$100.** The LX30 WB system board has a cacheless architecture for 486-based processors with internal write-back caches. According to the company, the board rival traditional system boards containing 128- and 256-kbyte cache designs. The board complies with the EPA's Energy Star program. <$100 (OEM). **Micronics Computers Inc**, Fremont, CA. (800) 577-0977. **Circle No. 431**



**Multigigabyte 3.5-in. disk drives have 7200-rpm spindle speeds.** The Capricorn Model 3243 provides 4.29 Gbytes of formatted capacity and an average rotational latency of 4.17 msec. Seek time is 9 msec. The drive comes with a Fast SCSI-2 interface ($3765) or an audio/video-optimized Fast Wide SCSI-2 interface ($3895). The Taurus Model 4221 offers 2.1 Gbytes of formatted capacity in a 1-in.-high form factor. $2320 and $2410, respectively. **Micropolis Corp**, Chatsworth, CA. (818) 709-3300.

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**Quad-speed CD-ROM drive has 120-msec random seek.** The XM-3501 CD-ROM drive has a sustained 600-kbyte/sec transfer rate. The drive has a 256-kbyte data buffer and uses a SCSI-2 interface to provide a synchronous-data-transfer rate of up to 4.2 Mbytes/sec. Power consumption is 5W avg and 6.7W max. A fully sealed enclosure protects the drive mechanism, resulting in a 100,000-hour MTBF. Suggested prices are $470 for the internal drive, $600 for the external drive, and $2470 for a four-drive system. **Toshiba America Information Systems Inc, Disk Products Division**, Irvine, CA. (714) 457-0777.

**Circle No. 433**

**Eight-port serial interface card for PCs transfers 115-kbps/port.** The Intelligent Serial Interface Model ISI608 buffers incoming data until the PC's processor can handle it. According to the company, the card's send and receive buffers ensure data integrity with any software, modem speed, or serial-port technology in the PC hardware. The board comes with software drivers for Novell's AIO specification. $599. **Multi-Tech Systems Inc**, Moundsview, MN. (612) 785-3500.

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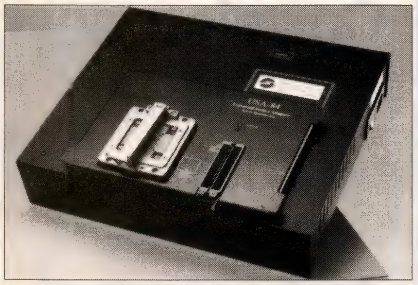

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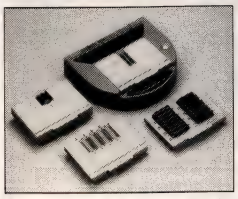

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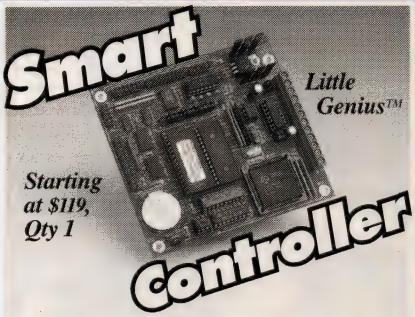

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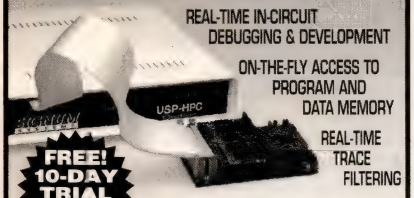


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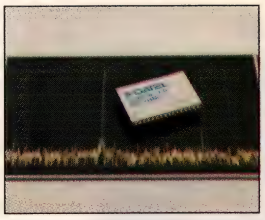

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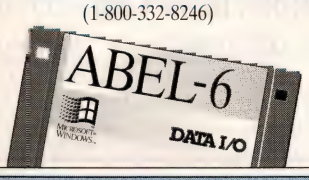


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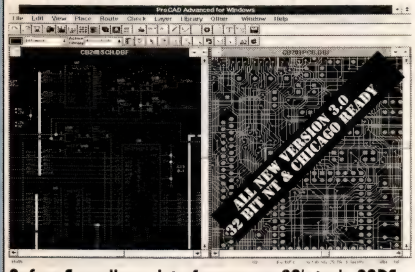


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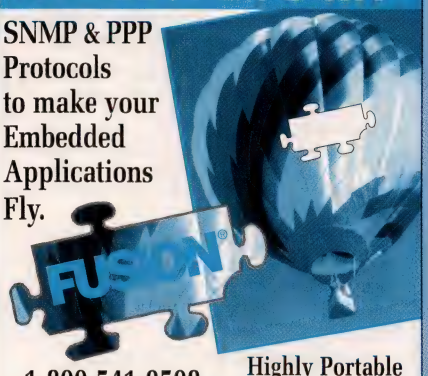


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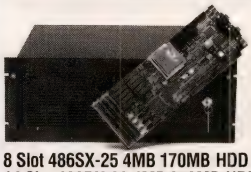

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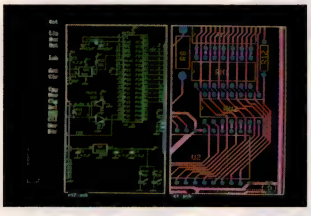

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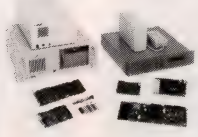

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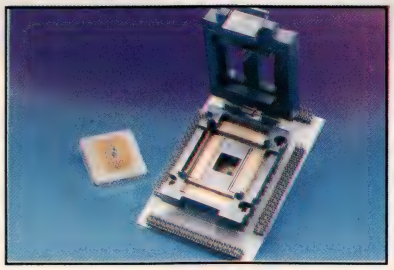

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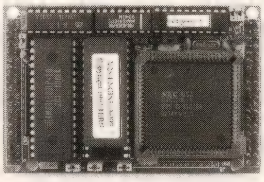

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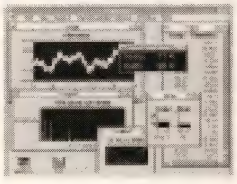

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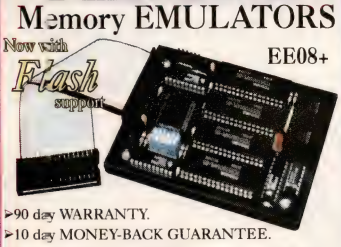

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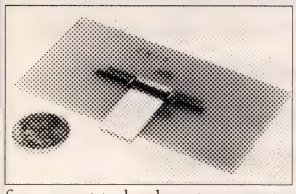

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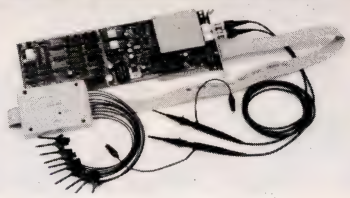

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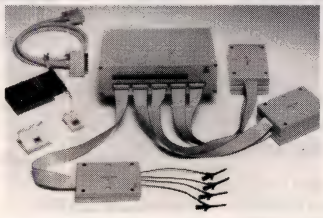

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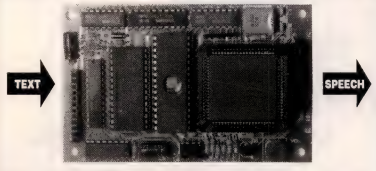


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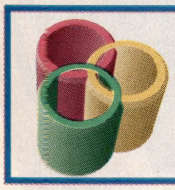

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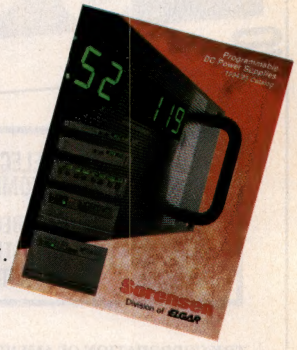


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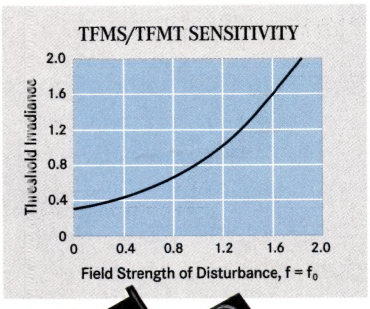


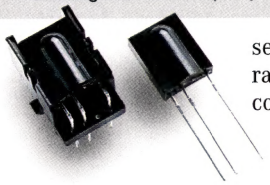

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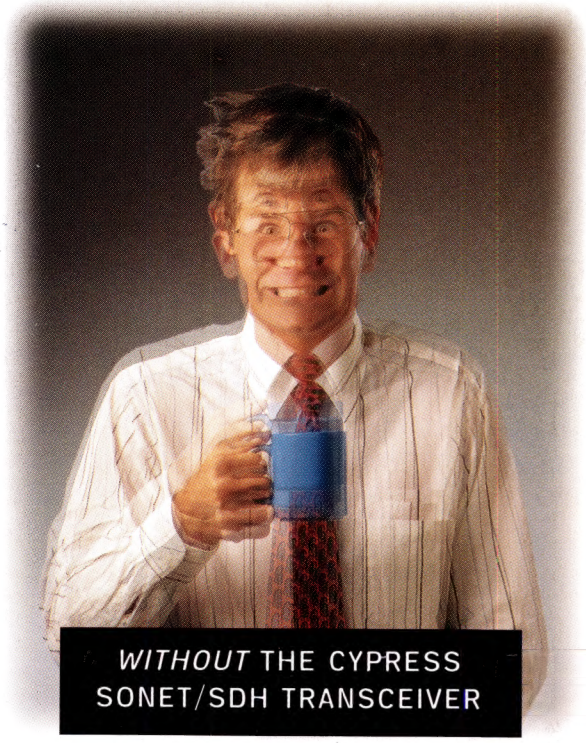
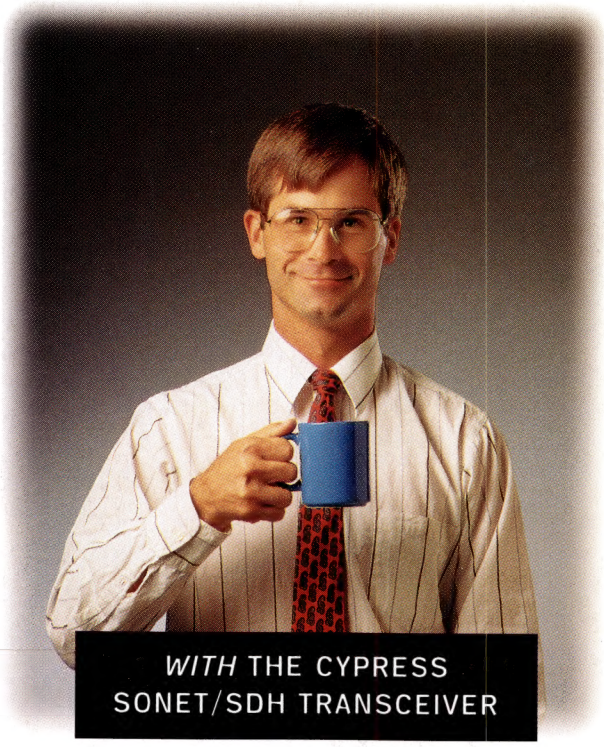
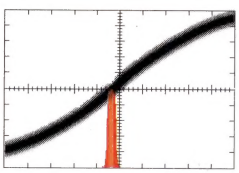
# DELICIOUS ATM, WITHOUT THE JITTERS.



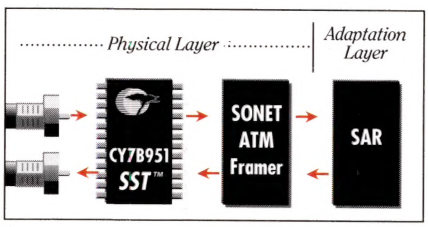

Here's a wake-up call for anyone designing-in ATM functionality: the CY7B951 SST™ (SONET Serial Transceiver) clock recovery chip from Cypress. With its miniscule jitter of just 10 ps, the SST is as close as you can get to guaranteed flawless performance in your ATM environment.



*Industry's Lowest Jitter*

In fact, it is the only solution to support both major ATM application frequencies (51.8 OC-1 and 155.52 MHz OC-3.)

Thanks to its integrated transmit and receive phase lock loops, the SST lets you use a low-cost 19.44 MHz oscillator. The SST also performs wonders for board space by eliminating the need for external filter components.




By using advanced BiCMOS technology, the SST consumes a miserly 50 mA, for power savings of up to 50% over competitive devices. And its loop-back testing capabilities enable in-system diagnostics.

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